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THE ELECTRICAL SECTION OF THE BUREAU OF MINES.

The United States Geological Survey organized an electrical section in 1909 to investigate the conditions under which electricity is used in mines, and since the creation of the Bureau of Mines this work has been continued by the new bureau. The use of electricity underground is accompanied by dangers peculiarly its own, since the dampness and the presence of explosive gases constitute conditions not ordinarily found elsewhere. Added to this is the liability of roofs to fall and subject the equipment to the danger of wreckage.

Danger from shock, from explosions and from fire constitute the greatest menace in this application of current, but the handling of explosives in the vicinity and their detonation by the electric spark add to the possible sources of casualties.

The problem of safeguarding life is rendered difficult by the fact that many of the miners do not appreciate the dangers and ignore the rules made for their protection. Anything that can be done to render the equipment or the conditions of current practice less hazardous will constitute an important advance in the mining industry and the Bureau of Mines is to be commended most highly for the researches which it is carrying on in this connection.

Elsewhere in this issue will be found the results of the tests which have already been carried out on fuses. These fuses represent the product of seven different manufacturers, and while certain ones withstood the test comparatively well, it developed that none are free from hazard. Tests carried out under such conditions will be of great help to the manufacturer in developing equipment which will be entirely satisfactory in every respect.

Other important investigations are under way, and much valuable information may be looked for in the near future as a result of these researches. The presence of acid waters in mines makes it necessary to examine insulation not only for its moisture-resisting properties, but also for the action of such weak acids, and an investigation of this kind is now being made. Another research which is being conducted deals with the action of electric sparks and arcs in coal dust. The presence of commutator motors and exposed switches, and the chance for short-circuits all add to the possibility of sparks and arcs and in the presence of

explosive mixtures of coal dust these may be the source of great danger.

Among other investigations to be undertaken as soon as possible are one on the danger of using electricity in the vicinity of explosives, one on electrical shot-firing devices, and a study of devices for the protection of the trolley wire.

The most powerful antidote for the dangers arising from conditions not altogether ideal, is the education of the miners to a realization of the dangers and an understanding of the conditions which make for safety. It is too much to expect, however, that every gang foreman shall acquire the technical knowledge which will enable him to discriminate between the cases where a certain practice is dangerous and where it is not dangerous. There should be a mine electrician who is competent to decide such matters, and moreover, there should be government inspectors who are competent to pass upon electrical conditions and electrical equipment, and who have authority to stop work under any conditions which are deemed dangerous to life. Only under such circumstances can the full measure of benefit from electrical auxiliaries be realized in mining operations without undue hazard to the miner. Electrical equipment is now applied for haulage, lighting, pumping, drilling, coal-cutting, hoisting, ventilating and also for signaling and detonating explosives. Every effort should be made to secure conditions which will put these services to use in every mine, and even extend the applications to fields as yet untouched.

TELEPHONES IN TRAIN DISPATCHING.

In spite of some opposition by a few of the old and more conservative of telegraphers and railway men there can be no doubt that the use of the telephone as a means of transmitting train orders is rapidly increasing. One reason for this is that, while the care necessary for the proper operation of the system is not minimized in the slightest degree, the need of men highly specialized in the pure mechanism of sending is done away with. All in all there seems to be a smaller number of factors conducive to error.

A tentative set of rules prepared by a company devoting special attention to telephone train-dispatching is described upon another page of this issue. It is worthy of study and of adoption by systems which have found the telephone to be especially applicable to its dispatching work. It is worthy of note that here the use of the word "Hello" is entirely abolished as it is being in other modern telephone work. The replying dispatcher gives the name of his station, the calling dispatcher answering by the word "Right." Numbers are both spoken and spelled out, practically eliminating the possibility of error.

While the telephone is perhaps a little more liable to abuse than the telegraph instrument, it can hardly be denied that tangled orders, which by the old method would involve long messages backward and forward, may be easily straightened out by a few moments of telephonic conversation.

THE TAXATION OF FRANCHISES.

The Supreme Court of California has decided in a case cited this week in our LEGAL NOTES that it is within the power of a county to tax the franchise of a company for the use of public highways in that county, even though the franchise was granted by the state. The question of taxation of franchises which is thus brought up by the telegraph companies in California is one which is also appearing in other states, and which should receive very careful consideration both by those directly interested and by the people at large.

The proper basis for the taxation of a franchise rests upon the use attached thereto of public highways, or other public property, by the corporation for private purposes. While the use made by a public-utility corporation of its equipment is in one sense a public use, since it is for the service of the public in general, it is also in another sense a private use, since it is not always for the benefit of the local community. In the case of a transportation company, or long-distance telegraph or telephone company, the use of the utility is mainly by persons outside of the local community where the franchise is in effect. It is only proper that some return should be made to the local community for the use of its highways, it being, of course, understood that such payment must come ultimately on those who make use of the public utility, that is to say from the latter's customers.

On the other hand, where the public-service corporation is doing a purely local business, as is the case with many of the utilities in every city, the use of the utility is very general among those members of the community in which the franchise has been granted. To tax the franchise means necessarily slightly higher rates for service, at least in those cases where the rates are subject to government regulation; consequently, such a tax is paid ultimately by the public at large in the community for whose benefit the tax is levied. It may, therefore, be questioned whether in such cases there is any object in imposing such a tax. Of course, if all citizens of the community made equal use of the public utility they would be taxing themselves uniformly through the imposing of a tax on the franchise. Since, however, this is usually not the case, and the service demanded of the utility by different citizens is entirely different, it seems very reasonable, and more strictly just, that a tax should be levied upon the franchise to be paid ultimately in the proportion in which use is made of the utility. Where such a tax is imposed it must always be paid out of current receipts for service, and where there is governmental rate regulation this element of cost must always be considered in determining rates.

In cases where the rates are not subject to such regulation, but are determined by "what the traffic will bear," the taxation of a franchise may not be so readily transferred to the users of the utility through their effect upon rates. In such cases there may be a clear gain to the community and a clear loss to the corporation by the imposition of such a tax. In some such cases where the franchise constitutes a monopoly, it may have to the corporation a large commercial value over and above the immediate value of the community property which is utilized in conducting its service, since in many cases the possession of such a franchise enables excessive rates to be charged. Such value is a purely artificial one, which disappears when the utility is subjected to rate regulation, since in the valuation of the property of the corporation only those elements of franchise value which represent payments actually made by the company should be considered. Such artificial value should not be the subject of taxation, even though it represents a benefit to the corporation at the expense of the community. The proper adjustment of such artificial relations resides in the regulation of rates.

DEPRECIATION AND APPRAISALS.

It is generally admitted that in the management of public-service corporations it is essential that provision be made for depreciation of the plant, and that the depreciation fund should be separately accounted for. A general appreciation of this necessity is, however, rather recent, and in the past many companies have failed to give this matter due consideration. As a result there are today many corporations which have made no definite provision for depreciation either in the matter of accounting or in the reservation of funds for the purpose.

In making appraisals of the plants of public-utility companies for rate-making purposes it is necessary to consider these conditions, since a proper allowance for investment in the plant cannot be determined without a consideration of the bearing which depreciation may have upon the matter. It may be assumed that the value of the present plant of any utility may be determined in its new condition either by appraisal or by reference to the first costs. Where a proper reservation has been made for depreciation and renewals this cost of the new plant also represents its actual present value, since the means are at hand for making replacements to the full extent to which the plant has deteriorated.

In cases where no such reserve has been provided for the depreciation, the question is not so simple. Two conditions must here be considered. In the one case it may be that the funds which in previous years should have been set aside for depreciation have been dissipated by declaring excessive dividends upon the stock, and consequently the value which has been lost in the property of the plant has been returned to the investors. It is evident in such a case both that the plant does not possess its original value and that the investors have no longer such a large interest in it as originally. It is perfectly proper in such a case, in appraising the plant for rate-making purposes, to consider only the depreciated value of the plant; that is, to deduct from the cost value the loss due to wear and tear and other items which go to make up the total depreciation.

In other cases, however, the failure to provide suitable funds for depreciation and renewals is due to the fact that the receipts from operation have not been sufficient therefor. The entire net receipts may have been only sufficient to pay a fair return upon the investment, or in some cases even this return may not have been made. Although it would have been proper to set aside a depreciation fund from the current revenues, these revenues have not been sufficient to make such a proceeding possible. This is often true of public utilities in the early years, which are generally designated as the development stage. In such cases the depreciation of the physical property must be regarded as a development expense which has not yet been met, but one which is, nevertheless, chargeable against the total cost of constructing the plant and putting it in commercial operation. In such cases it is unfair to consider only the depreciated value of the plant in determining the fixed charges. It is quite proper, on the contrary, to value the plant at its original cost, and when additional capital must be brought in to cover renewals this should be regarded as an additional item of fixed charge. This is equivalent to allowing for development expenses in a case where capital has been originally set aside for this purpose and a depreciation fund has been accumulated from the current receipts.

For the present and future, public-utility corporations should, even in those states where they are not yet subject to regulation, recognize that depreciation should properly be taken from current funds, and where rate-making commissions exist they will approve rates that make this possible.

Where a consolidation of two or more public-utility companies has been made, with a consequent scrapping of certain apparatus which becomes unnecessary, such scrapping should not be regarded as coming under the domain of depreciation, since the cause of the scrapping is not obsolescence but merely an unavoidable duplication of equipment which is no longer needed. In adjusting the rates under such conditions every case must be treated upon its own merits, and it is seldom fair to regard the present value of the physical plant as the sole basis for fixed charges. Rate regulation is justified by the granting of a monopoly to a single operating company. Where such a monopoly has not existed through the exercise of rights conferred by franchises, but has only been gained by the consolidation of competing companies, the conditions do not warrant the same attitude on the part of the public or of the rate-making commission that would be appropriate where the original franchise granted a monopoly.

Annual Meeting of National Electrical Contractors' Association.

(Special Telegraphic Dispatch.)

NIAGARA FALLS, N. Y.—The eleventh annual meeting of the National Electrical Contractors' Association was opened Wednesday morning, July 19, by President Marshall L. Barnes, who said he was glad to see so many representatives of the manufacturers and jobbers present. Certainly the several elements engaged in the commercial development of electrical industry were getting closer together and the evidence of the growth of the spirit of co-operation augured well for a very definite improvement of conditions.

The first paper on the program was entitled "The Proper Lamp for the Circuit," by Paul F. Bauder. This paper was read by R. E. Campbell. The paper analyzed the relations of the contractor with the consumer and central station and showed how a proper control and selection of the proper type of lamp, carbon, Gem, tantalum or Mazda, in conformity with line voltage, was necessary in order that the highest efficiency in service might be secured. The manufacturers of incandescent lamps have worked out the three-voltage rating for incandescent lamps so that the right ones might be selected for every variety of service. In order that the consumer would get the benefit of better lighting it was necessary for the contractor to co-operate with the lamp manufacturer in educating the consumer to observe the rules under which successful installations may be introduced. The contractor must familiarize himself with data relating to surface, area, color and tone of walls and ceiling and interior decorations and furnishings, with the variations of illuminating intensity involved in different heights of ceilings, and with the effect upon the useful life of the several types of lamps of fluctuations in line voltage.

The next paper was entitled "Credit Protection," by Franz Neilson. This paper, which was read by James R. Strong, emphasized the desirability of the contractors getting together for the protection of their credits. The plan was entirely feasible, and would reach its greatest success if allied with other credit associations of subcontractors in the building trades. Those customers of the contractors who, by repudiations, excessive exactions or the withholding of payment on long-overdue accounts, worked injury to the contractors, would have a speedy awakening of conscience if their credit was universally declined. The method of procedure in gathering information, in posting delinquents and in extending credit information was legal and the spirit of the Association was indorsed by the jurists of today.

President Barnes reported the completion of the work of the committee having in charge the memorial to Alexander Henderson and the dedication of this memorial at Southampton, N. Y., last week. A message was read from Mrs. Henderson thanking the friends of Mr. Henderson for their splendid generosity.

The session closed with the reading of a paper entitled "Co-operation in the Electrical Industry," by Philip S. Dodd, who outlined several methods of co-operation which were being worked out.

M. L. BARNES,
President National Electrical Contractors' Association.

The directors of the Association held a business meeting on Tuesday and a business session was held on Wednesday afternoon. The entertainment features included an automobile ride on Wednesday afternoon, reception and dance at the International Hotel on Wednesday evening, rejuvenation of the Sons of Jove, Wednesday evening, a dinner at the International on Thursday evening, trips around the Niagara Gorge route and a baseball game on Friday.

There was a large attendance of contractors, supply men and manufacturers, among whom were:

M. L. Barnes, Troy, N. Y.; W. H. Morton, Utica, N. Y.; J. C. Hatzel, New York; George W. Eiderman, New York; E. McCleary, Detroit; James Hilton, Syracuse, N. Y.; C. R. Kreider, Chicago; Ernest Freeman, Chicago; Henry Newgard, Chicago; J. C. Sterns, Buffalo; J. B. Olson, Habirshaw Wire Company; A. S. DeVeau, New York; C. E. Corrigan, National Metal Molding Co.; George S. Searring, Chicago; B. G. Kodjbanoff, Benjamin Electric Manufacturing Company; Arnold Friend, M. B. Austin Company; A. H. Kling and L. M. Robinson, Detroit Fuse & Manufacturing Company; A. S. Merrill, Chicago Fuse, Wire & Manufacturing Company; W. Van Horn, Clifford Skiles and George Loring, Shelby Electric Company; E. S. Keefer and R. Gordon, Western Electric Company; E. A. Williams, Colonial Electric Company; E. V. Hennecke, Art Brass & Fixture Manufacturing Company; Philip S. Dodd, P. F. Bauder and R. E. Campbell, National Electric Lamp Association; W. F. Wendel, Conduit Wiring Machine Company; Chas. H. Austin, Nashua, N. H.; V. C. Gilpin, New York; J. D. Underhill, Okonite Company; R. H. Tillotson, Appleton Electric Company; W. S. Bissell, Bissell Company; C. B. Cushing, National Metal Molding Company; W. P. Hawley, manager, W. L. Bliss, chief engineer, A. P. Packer, A. O. Heister and Alex. Russell, United States Light & Heating Company; H. B. Kirkland and Robert L. Jaynes, American Conduit Manufacturing Company.

A. A. G.

The Chicago Electric Club.

The meeting of the club on July 12 was to have been addressed by C. G. Osborne of the Illinois Steel Company on "The Utilization of Electricity in Steel Works." Owing to the enforced absence of Mr. Osborne from the city his recent paper before the American Electrochemical Society was abstracted by A. A. Gray. Mr. Gray prefaced the abstract with a brief sketch of the electric furnace and its development, and spoke of the different types of furnaces in use. The report of the committee on the luncheon to the American Institute of Electrical Engineers was also made at this meeting. It showed that the net cost to the club had been $393. The attendance at the luncheon was 450. A discussion followed as to the advisability of holding a picnic in August, and a motion was finally made to take a letter-ballot of the membership on this proposition, the cost being limited to $250. This motion was carried and the question of holding a picnic therefore remains to be decided by the members of the club.

Reduction of Lighting Rates in Cleveland.

The Cleveland Electric Illuminating Company has announced a reduction in rates. This concern uses the two-rate system and formerly charged 12.5 cents and 5 cents per kilowatt-hour. The rate has now been cut to 10 cents and 5 cents per unit. The reduction amounts to about six per cent. The Company announced this on July 17 and thus anticipated action by the City Council, one of whose members had an ordinance prepared for the purpose of reducing the rates to a lower level.

Svante August Arrhenius.

Not infrequently has history repeated itself in the casting of the stigma of doubt and distrust upon those hardy investigators in the realm of science who have had the courage to announce some startling development in our knowledge of physical and chemical laws, overthrowing ideas apparently well established and indorsed by contemporary leaders of the day. Consistently with this caprice of the scientific world to cling too closely to established ideas and to discount most learnedly the efforts of those who would bring enlightenment, when Arrhenius first announced his theories upon electrolytic dissociation the correctness of his views was immediately disputed, and some of the biggest men of science of the day overwhelmed him with disparaging criticism. In fact, his treatise upon galvanic conductivity of electrolytes, which was later to secure for him the Nobel prize, when presented in connection with his application for the post of general lecturer at the University of Stockholm, barely escaped rejection.

SVANTE A. ARRHENIUS,
Director of the Nobel Institute, Stockholm.

Svante August Arrhenius was born near Upsala, Sweden, February 19, 1859. His early education was received at the Lycee of Upsala, and his scientific studies pursued at the gymnasium and the University of Upsala. Upon graduation he removed to Stockholm. He there entered the Scientific Academy, pursuing special courses in physics, mathematics and biology. He later joined the Physical Institute of the Academy of Sciences at Stockholm, and under the guidance of Prof. E. Edlund made a series of researches into the subject of electric conduction which led him to his conception of electrolytic dissociation. His paper on this subject, as noted above, presented views so startling that it received very little appreciation. Failing in his attempt to secure the post of general lecturer at the University of Stockholm, he was appointed lecturer in a minor physical and chemical branch. While there, so successful was he in extending his previous researches, that his progress began to attract the serious attention of great men of science, and he became in a way a protégé of Dr. Wilhelm Ostwald.

In September, 1884, Arrhenius and Ostwald attended together the Scientific Congress held at Magdeburg, where their friendship ripened, and where plans were laid for a continuance of the researches of Arrhenius at the laboratories of the Polytechnic School, in Riga, Russia, of Professor Boltzmann, in Graz, of Professor Kohlrausch, in Würzburg, and of the late Professor Van't Hoff at Amsterdam.

Arrhenius had now carried his work to a point where his theories were receiving the support of many co-laborers, and he had been led to expect the professorship of natural philosophy at Utrecht, and of chemistry at Graz. It was not until 1891, however, that he was offered the chemistry professorship at the University of Giessen. This was declined because at that time the post of chief instructor in physics at the University of Stockholm was vacant. He was unable to secure this, and after considerable delay succeeded in obtaining the chair of physics, during 1891, at a private university in Stockholm. Four years later this post was advanced to a professorship, and Arrhenius became a candidate. He was subjected to a competitive examination by a committee composed of Dr. Hasselburg, representing Sweden, Dr. Christiansen, representing Denmark, and Lord Kelvin, representing England. Dr. Christiansen fully indorsed Arrhenius against all other candidates, but he was opposed by Dr. Hasselburg and Lord Kelvin, the latter very decidedly rejecting the Arrhenius theory of ions. This matter, however, was prevented from reaching an unhappy termination upon the intervention of Dr. Ostwald and other friends of Arrhenius, who took up the cudgels in defense of his theories, and the professorship was accorded him. This he retained until 1897, when he was nominated president of the Stockholm University, remaining in that position until 1902.

Arrhenius has contributed largely to our knowledge of cosmical physics, and has made many valuable researches in physics and chemistry as well as into the phenomena of electrical conductivity. He is the author of "Worlds in the Making," "The Evolution of Universes," "Conceptions of the Universe in Theory," "The Life of the Universe," "Immuno-chemistry," "Electro-chemistry," "Theories of Chemistry," and a treatise on serum-therapy.

Arrhenius has received many distinctions and is a member of many scientific associations. He is director of the physico-chemical department of the Nobel Institute since 1905, and was given the degrees of Doctor of Physics, 1884; M. D., Heidelberg, 1903; Doctor of Science, Oxford and Cambridge, 1908; Doctor of Philosophy, Leipsig, 1909. He received the Davy medal in 1902 and the Nobel prize for chemistry in 1903.

Dr. Arrhenius delivered a series of lectures at Yale University this spring, and has since delivered many lectures in this country. On May 12 he was tendered a reception and dinner by the Chicago section of the American Chemical Society, when he was made recipient of the first Willard Gibbs medal.

Alexander Henderson Memorial.

On Sunday, June 16, a number of the friends of the late Alexander Henderson assembled at the home of his daughter, Mrs. Gilmartin, at Southampton, Long Island, to participate in the dedication of a memorial to Mr. Henderson in the form of a monument over his resting place. A number of the members of the National Electrical Contractors' Association, en route to their annual convention at Niagara Falls, were in attendance.

Addresses were made by Marshall L. Barnes, president of the National Electrical Contractors' Association; J. C. Hatzel, of Hatzel & Buehler, New York City, and S. Davis.

Among those in attendance were: Mrs. Alexander Henderson, Mr. and Mrs. Gilmartin and their two children, Miss Marian Henderson, J. R. Strong, E. S. Kiefer, Marshall L. Barnes, J. C. Hatzel, S. Davis, George Weiderman, A. S. De Veau, of the De Veau Telephone Manufacturing Company; William Hurley, of the Sprague Electric Company; Mr. Schieren, of the American Circular Loom Company.

Twenty-five-Year Subway Leases.

At the present time in Boston and New York the future transportation problem is before the public and the city. In Boston the discussion is centered more on the period of lease than on any proposed extensions, and the report of the Committee on Public Utilities, of which Dugald C. Jackson is acting chairman, to the Chamber of Commerce, distinctly shows that the committee believes a 25-year lease can be worked out on a fair basis.

"The Committee is unanimously of the opinion that it would not be in the public interest to give an option at the present time for the extension of these leases beyond 1936, with the possible exception indicated below. The advance in the methods of transportation during the past twenty-five years, and the increase in the number of passengers transported resulting therefrom, have been tremendous. What changes will take place within the next twenty-five years, and what the conditions will be at the end of that period, no sane man will undertake to say; and it seems to your Committee a sacrifice of a most important power of determination to deprive the next generation of the opportunity to avail themselves of such improved methods of transportation and such desirable changes and additions to their transportation facilities as may at that time seem wise—the nature, extent, and importance of which cannot now be foreseen—and to decide for them, in advance of any knowledge, the conditions under which these subways, which may very likely always be the central and controlling factor in the transportation facilities of our city, shall be occupied and utilized. They are entitled to such transportation facilities as may at that time seem to them essential, and the cost of which they are willing to pay. What transportation facilities will be at that time essential, and the conditions under which it will then be fair to ask the Transportation Company to provide those facilities, we do not at this time know.

"It has been urged that the additional subways which these leases cover will not during the first few years of their operation bring in sufficient additional revenue to pay the rental thereof, at the rate fixed in the pending act, and that it is not fair to the company, and not in the interest of the public, to ask the company to take a 25-year lease of them upon terms which would be fair for a 50-year lease.

"It is obviously true that conditions which would be just and fair under a fifty-year lease, and which would enable the company to finance its needs on favorable terms, may very well be unjust to the company and not in the interest of the public if the term is to be twenty-five years; but your committee desires to point out that neither the company nor any public body or board has yet undertaken to say what terms and conditions or relief from other terms and conditions would be fair for the company if the term of the leases is to be twenty-five years. We believe that if a vigorous, determined and intelligent effort is made to do this, a fair basis for twenty-five-year leases can be worked out.

"The Committee unanimously recommends that at least until this is done and the public has had the question clearly presented for its consideration as to whether it prefers twenty-five-year leases with whatever concessions by it may necessarily and properly accompany them, or the longer term leases with the disadvantages acompanying them, the Chamber oppose the passage of any act providing for the leasing of the existing and prospective subways for the longer period."

Convention of Ohio Electric Light Association.

The seventeenth annual convention of the Ohio Electric Light Association will be held at Cedar Point, O., July 25 to 28. Headquarters will be at the Breakers Hotel. New arrangements have been made by the hotel management for a convention hall and exhibit hall. The building formerly used as a theater has been reconstructed, the first floor being arranged for exhibits and the upper floor as a meeting hall. A number of interesting exhibits have been provided.

There will be but one session each day of the convention, thus allowing plenty of time for recreation and informal discussions. The first session will be on Tuesday afternoon, July 25, and the last session will be on Friday morning, July 28.

The entertainment features include an informal dinner and dance on Tuesday evening, a banquet on Wednesday evening, an informal dinner and vaudeville on Thursday evening. Water ball and base ball games will also serve as entertainment between sessions.

For the ladies there will be musicales, card games, bowling parties, a launch ride, and other diversions.

In addition to committee reports and the president's address, the following papers will be read: "Why the Central Station Should Take Over the Isolated Plant," by Waldo Weaver; "Systematic Central-Station Records," by O. B. Reemelin; "Limiting the Energy Demand and Voltage Variation of a Circuit by Floating a Fly-Wheel Motor-Generator on the Line," by A. M. Seeger; "Boulevard Lighting System," by G. A. Doeller; "Advantageous Uses to which Mercury Arc Rectifiers may be put on Central-Station Lines," by T. J. Kermode; "The Utility Law of Ohio and its Application to Electric Light Companies," by D. L. Gaskill; "Pumping Water for Municipalities and for Irrigation by Electricity," by B. H. Gardner; "Motor-Driven Refrigeration," by W. C. Anderson; "The Use of Tungsten Lamps in Sign and Outline Lighting," by W. B. Goudey; "Progress of Electrical Cooking in Small Towns," by P. L. Miles.

Committee Reports will include "Electrical Transmission," "Meters," "Insurance Rates of Electric Light Stations of Ohio," and "Motor Applications."

Cedar Point is reached by steamer from Sandusky, Toledo, Cleveland or Detroit, or by electric cars.

Georgia's Greatest Power Development.

Plant of the Central Georgia Power Company at Lloyds Shoals.

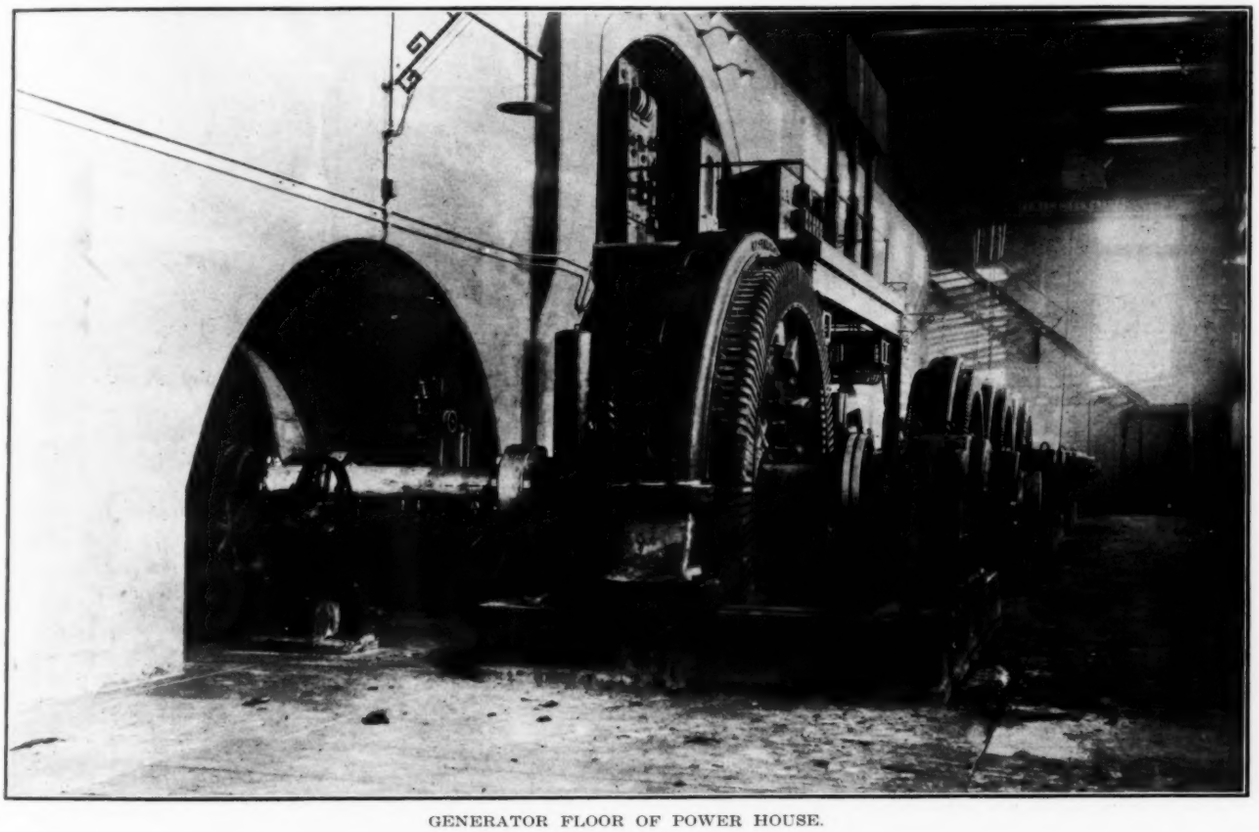
Almost within a stone's throw of the point at which General William Tecumseh Sherman with his troops, crossed the historic Ocmulgee River on his memorable march from Atlanta to Savannah, Ga., now stands the largest hydro-electric development in Georgia and one of the most perfect of its size and nature in the world. Even to the layman it provides a striking example of the thrift, enterprise and rapid development of the New South.

Like the Savannah, Chattahoochee and other rivers in Georgia, the Ocmulgee rises in the mountains and the Piedmont Plateau and flows in a succession of rapids until it comes to its fall line. Like them, also, the fall of the Ocmulgee occurs within the distance of a comparatively few miles of the river's course.

All of these Georgia rivers are subject at intervals to extreme droughts as well as great floods, causing a very wide range between minimum and maximum flow, and since the Ocmulgee possesses, in a high degree, natural features permitting the creation of large storage capacity, it is readily susceptible for the development of power.

The point of development is midway between the cities of Atlanta and Macon, Ga., which are about one hundred miles apart and between which the Ocmulgee River falls some 527 feet.

The site of the development is located at the foot of Capps and Lloyds Shoals and immediately below the point at which the Ocmulgee is formed by the confluence of the South, Yellow, Alcovy and Tussahaw Rivers as appears in the accompanying map.



GENERATOR FLOOR OF POWER HOUSE.

The dam is thrown between two high bluffs in a narrow neck of the river. These bluffs, together with the entire bed of the river, being composed of solid gray granite, constitute an admirable foundation for the dam and its abutments.

As the result of the union of the four streams mentioned, there is afforded a storage reservoir which consists of a large main body of water with the different streams forming, as it were, extensive arms, thereby giving a far greater storage and volume of water than would be afforded by a single stream. It is doubtful whether there exists elsewhere in the South a water-power site combining these valuable features to the same extent. The creation of the reservoir resulted in the backing up of the water in the different streams above the dam to a distance of about fifteen miles.

The surface area of the reservoir is about 4,000 acres and it is estimated that it contains upwards of 4,000,000,000 cubic feet of water. The storage area serving the reservoir is about 1,350 square miles, while the discharge at the dam averages about 1,800 second feet.

Like all other similar reservoirs, that on the Ocmulgee has already proven its value from the standpoint of practical conservation, in that it regulates the flow of the river and is admitted to be of inestimable value alike to water users and property located below the dam.

All timber and underbrush in the area covered by the reservoir, was cut and thoroughly burned before the water was

raised in same. This was done as a precaution against fever or other illness arising from the creation of the reservoir, and as a result trouble of this nature will be eliminated.

In order also to secure the greatest possible storage area, it was found necessary to flood public roads at different points above the dam, to overcome which ten highway bridges consisting of steel trusses on concrete piers were constructed. In all cases these substantial bridges replaced flimsy old wooden structures which were usually flooded, and therefore impassable in times of high water; hence the creating of the reservoir has been a distinct benefit to the "good roads" movement in central Georgia.

DAM.

The dam, shown in one of the illustrations, is, at its crest, 103 feet above the surface of the water in the tail-race. It is constructed throughout of cyclopean concrete; large blocks of stone forming about one-fourth of the entire mass were embedded in a concrete mixture of cement and broken stone—in proportion of one part cement, three parts sand and six parts broken stone, with proper proportion of water. About 160,000 yards of masonry entered into the dam and abutments. The dam is 11 feet wide at the crest and 95 feet wide at the extreme base of the spillway which is formed by an ogee curve which takes the water down stream in an absolutely smooth flow. The masonry section of the dam between abutments is 1,070 feet long. The east abutment, 540 feet; and the west abutment, 100 feet long, making a total of 1,710 feet. The power house, which is integral with the dam is 190 feet long, while the spillway occupies 728 feet of the dam.

It is a matter of note that the only imported material entering into the construction of the dam proper was that of cement, fine sharp sand for the making of concrete being found in abundance in the channel of the river immediately below the dam, granite quarried from the banks and bed of the river, and timber required in the construction of coffer-dams, railways, etc., cut from lands which were subsequently to form the storage reservoir.

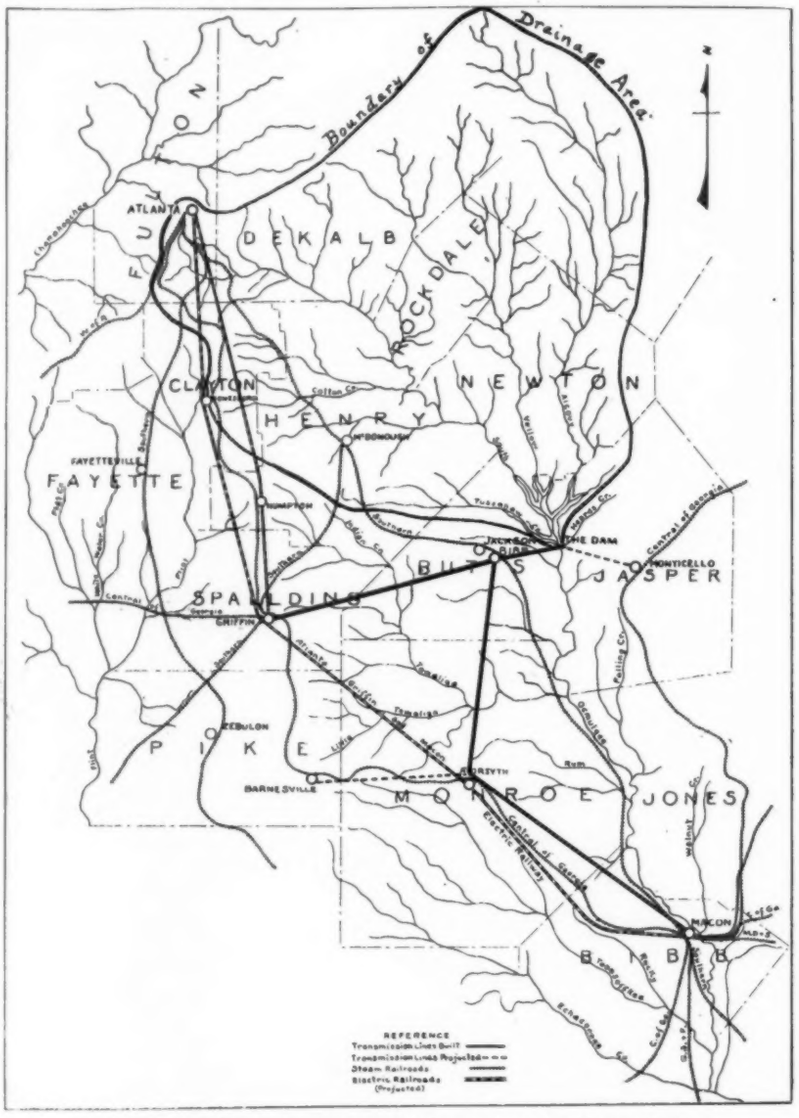
POWER HOUSE.

The power house is a brick and steel structure; the walls of the first floor being twenty inches thick, and those of the second floor sixteen inches thick. The floors are of reinforced concrete, carried on steel beams, while the roof is of similar construction covered with five-ply tar-paper and gravel. The plant is designed for six main generator units connected to water turbines.

A cross section of the power house showing the relative location of the dam, penstocks, draft tubes and general design of power house and arrangement of apparatus is shown herewith. As will be seen, the generator equipment is installed on the main floor, while the high-tension switching apparatus and transformers are installed on the upper floor.

The completely equipped operating switchboard is situated on a gallery immediately over the exciter units on the main floor. Entrances are provided on the generator and transformers floors, while access is also had to the building from the roof.

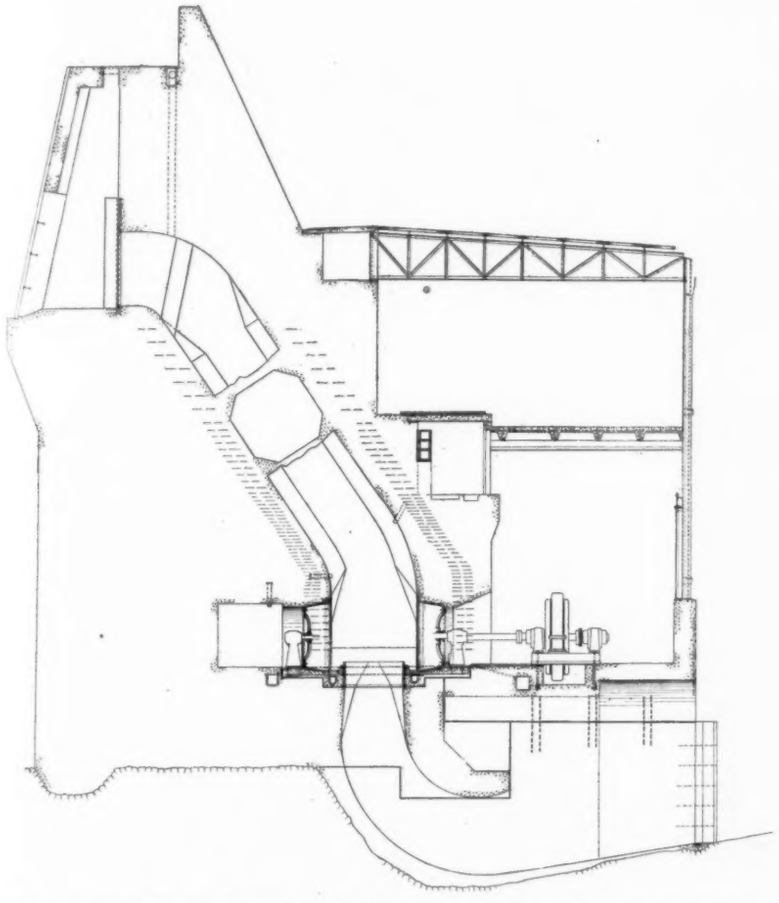
The hydraulic equipment throughout was furnished by the S. Morgan Smith Company, York, Pa. The generator turbines, which are of the twin wicket-gate type, are thirty-nine inches in diameter, and designed to develop 5,500 horsepower each. Each generator is governed by a 30,000 foot-pound motor-controlled Lombard governor. The two exciter turbines, which are of 535-horsepower capacity each were likewise furnished by the S. Morgan Smith Company. They are equipped with Woodward governors, and are directly connected to two 400-kilowatt exciters located in the center of the station; the intention being that one exciter serve the three generators located in the east half of the power house, and the other exciter serve the remaining three generators in the west half of the station.



MAP SHOWING TRANSMISSION LINES AND DRAINAGE AREA.

The chambers containing the water wheels as also the short penstock connecting with same are built in the dam. Only four of the generator units have so far been installed but it is intended to install the two remaining units, for which provision has been made, at an early date.

The electrical equipment throughout was furnished by the Westinghouse Electric & Manufacturing Company, Pittsburg, Pa. There are four 3,000-kilovolt-ampere generators driven by water wheels and four sixty-cycle, 3,000 kilovolt-ampere, three-phase oil-insulated water-cooled transformers in the power house. The high-tension voltages are 38,100, 36,945, 35,790, 34,635, volts delta and 66,000, 64,000, 62,000, 60,000 volts star; the low-tension voltages being 2,300, 2,200, 2,100, 2,000 volts delta.



VERTICAL SECTION OF POWER HOUSE ON CENTER LINE OF MAIN UNIT.

SWITCHING EQUIPMENT.

The current is led from each generator to a 1,200-ampere, 2,300-volt solenoid-operated automatic overload circuit-breaker equipped with definite time-limit relays. Under normal operating conditions, each generator feeds directly from this point through disconnecting switches and a duplicate circuit-breaker to the one described above to the low-tension side of the three-phase transformer which steps up the voltage to 66,000. Between two sets of disconnecting switches a tap is taken off to another set of disconnecting switches and circuit-breaker as described above to the 2,300-volt busbars or transfer bus. By means of this connection any generator can be connected, by the operation of the proper circuit-breakers, to feed any step-up transformer. From the high-tension side of the transformer the current is led through a 300-ampere, 66,000-volt oil circuit-breaker, thence through oil-immersed choke coils and disconnecting switches to the 66,000-volt busbars.

From the busbars the power is taken to the substations over either one or both of two feeders of 18,000 kilowatts capacity each. Before reaching the pole lines the feeders pass through automatic oil circuit-breakers, and disconnecting switches and are protected by electrolytic lightning arresters with horn-gap disconnecting switches. The 2,300-volt and the 66,000-volt buses are divided into two sections, each of the latter being connected to one feeder; they are connected in the center by two sets of disconnecting switches and non-automatic oil circuit-breakers, the former by a 2,000-ampere and the latter by a 300-ampere breaker. The oil circuit-breaker is erected in a structure of masonry, each pole being entirely inclosed in a separate fireproof compartment, and each line terminal being separated by soapstone barriers from adjacent terminals.

The breaker, used in connection with the 66,000-volt buses, represents the latest improvement in high-tension switching devices, and consists of three separate single-pole breakers, mounted each in its own iron tank, separate and distinct from the other, and connected by the operating rods. The contacts are of the well known "butt" type.

The 66,000-volt wiring, according to the latest engineering practice, is all open, consequently no inclosing structures are provided either for the circuit-breakers or the busbars.

The 2,300-volt wiring, on the other hand, is inclosed, and consequently the busbars, circuit-breakers and disconnecting switches are inclosed in fireproof masonry work.

Each of the 400-kilowatt, 250-volt exciters is connected to the exciter busbars and controlled from one panel of a black marine-finished slate switchboard, containing the proper knife switches and indicating meters. This switchboard contains, in addition to a panel for each exciter, one for the control of the station lighting and power circuits, which has mounted thereon a 2,300-volt, automatic overload, hand-operated, oil circuit-breaker and three two-pole single-throw knife switches.

The main switchboard is of the bench-type control equipped with a complete set of dummy busbars installed on the top of the control bench, enabling the operator to tell at a glance the connections that have been made by the operation of the electrically operated switches. This board was designed for the control of the four 3,000-kilovolt-ampere, three-phase generators and transformers with provision for two spare units of each, and the two 18,000-kilovolt-ampere, 66,000-volt feeder circuits.

The top of the bench board is composed of slate slabs with the sides, front

and rear of steel plate in the form of removable panels, so arranged as to provide ready access to the interior of the desk for purposes of inspection and adjustment.

All of the circuit-breakers in the station are electrically operated (except the one on the station-lighting panel) and are operated from the control bench by drum-type controllers mounted thereon. The operating handle and dial plate are on the top, while the controllers themselves are mounted inside, so that there is no possibility of the operator coming in contact with even the 250-volt operating circuits. All of the instruments and synchronizing equipments are operated from current and voltage transformers so the operator has no chance of making contact with any live circuits.

Each circuit-breaker controller is provided with two indicating lamps, one red to show the breaker closed and one green to show the breaker open. The red lamps are connected in the miniature bus system in such a manner that the attendant can tell the actual connections that have been made by the oil circuit-breakers.

For the purpose of showing the position of the disconnecting switches two miniature ten-volt lamps are connected in series, one being mounted on the control bench and connected in the mimic bus and the other mounted near the disconnecting switches. These lamps are fed from the ten-volt secondary of a small transformer and the lamp near the switch has connected in parallel with it a snap switch. When the attendant opens the switches, he turns the snap switch, thus short-circuiting the lamp and causing the lamp in the mimic bus with which it is connected in series, to burn at full candlepower, which notifies the operator that the disconnecting switches are open.

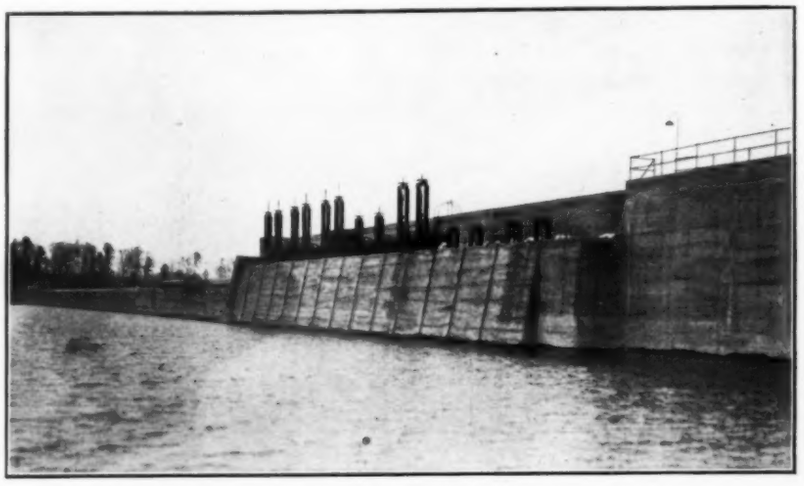
A complete set of synchronizing plugs and receptacles are included in the generator sections. The closing circuits of the oil circuit-breakers are so wired that the breakers cannot be closed unless the synchronizing plugs are in their receptacles.

A full complement of indicating instruments of the vertical edgewise type is included in the equipment. The instruments are mounted on a framework back of the control bench in such a manner that the operator will face the generator room when standing in front of the desk, and can look above the top of the bench and underneath the instrument frame to observe the operation of the machines. Watt-hour meters are installed on the rear of the control bench.

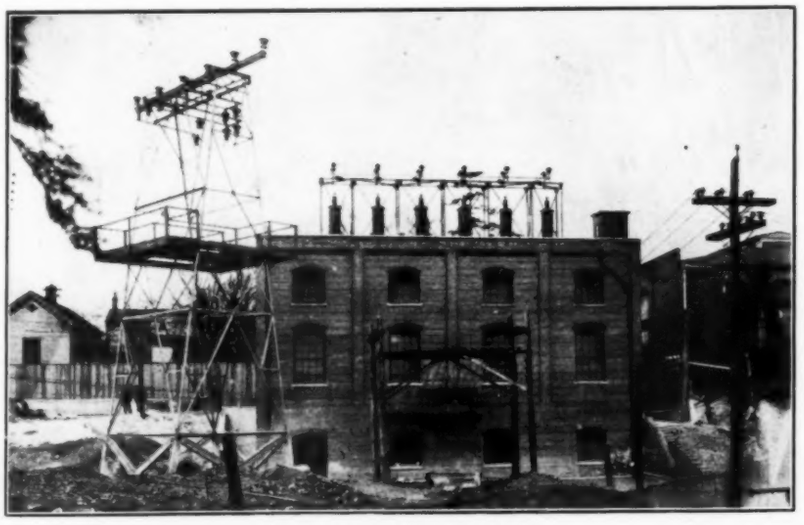
TRANSMISSION LINES.

The power is transmitted from the dam to Bibb, at which point it branches, by means of a switching tower, toward Forsyth and Macon on the south, and toward Griffin and Atlanta on the north. The system as at present constituted reaches only the cities of Macon, Forsyth and Griffin, but it is understood that same will be extended to Atlanta in the very near future. It is also the intention to extend the system from Forsyth to Barnesville and thence to Griffin, thereby completing a loop which will constitute the center of the system and into which will be fed all power from the three other plants on other rivers in central Georgia which the company contemplates developing as market conditions warrant. As will be seen in the map, such a loop will materially lessen the chances of interruption to service in that it will provide a means of supplying power to any of the cities mentioned over either of the legs leading from the switching tower at Bibb.

Arrangements have also been made to extend a separate line from the power house, over the top of the dam, to the city of Monticello, which is located on the east side of the river at a distance of about nine miles from the site of development.



VIEW OF DAM.



SUBSTATION AT MACON.

The distance from the dam to Bibb is six miles, from Bibb to Macon, forty-one miles, and from Bibb to Griffin, eighteen miles, making a total system of sixty-five miles in operation at the present moment.

One of the accompanying illustrations

shows the branch-off and sectionalizing tower used. The transmission towers, which were furnished in part by Riter-Conley Company, and in part by the Milliken Company, stand eighty feet high from the ground to the pinnacle of the ground-wire support. They are anchored at each of the four corners, each anchor being required to stand a strain of 30,000 pounds without failure. The top of the lowest insulator on the tower is fifty feet above the ground.

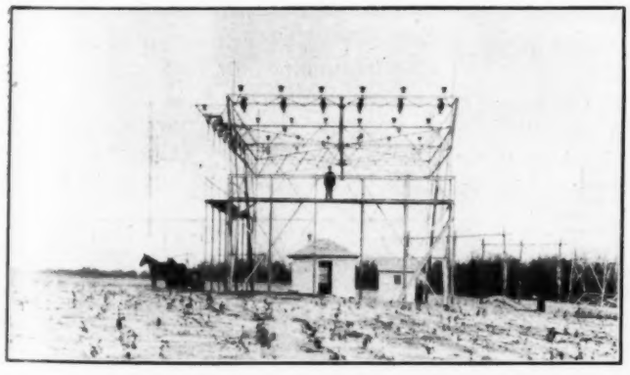
The towers, which are located with reference to the contour of the country, average about 500 feet apart. The conducting wires are sagged between same to a point at which their elasticity is least affected. These sags average about twenty-five feet at the center, but in no case do they drop within less than twenty feet from the ground. The clearance between line wires is 7 feet 6 inches. A copper-clad steel ground wire is carried on the center pinnacle and grounded at each tower.

From the dam to the switching tower at Bibb, the lines are of No. 00 B. & S. gauge copper, while from this point to the various cities mentioned, aluminum wire of No. 0 B. & S. copper gauge equivalent is used.

The general design of the line was very carefully worked out with a view to eliminating the troubles common to high-voltage systems.

The transmission-line right-of-way is owned by the company. It is 100 feet wide and was entirely cleared of standing timber before the construction of the line was proceeded with.

TRANSFORMERS AT FORSYTH SUBSTATION.



SWITCHING TOWER AT BIBB.

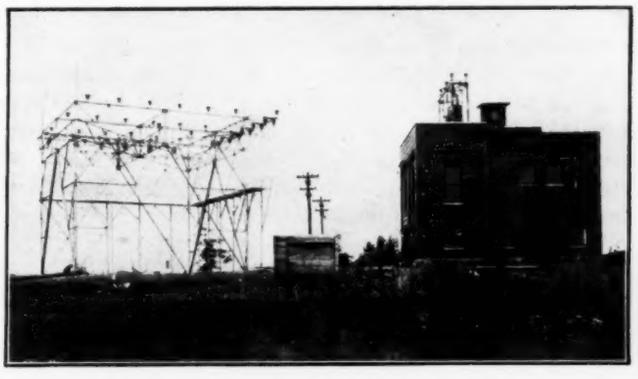
TELEPHONE SYSTEM.

The company has installed on its transmission towers a telephone system, the wiring of which is amply transposed so as to insure good voice transmission. The system is also elaborately protected against lightning discharges. Substantial booths with permanently installed telephone instruments are located at numerous points along the transmission line, while at numerous other points drop connections are provided so that patrolmen, all of whom carry portable telephone sets, may have ready communication with headquarters at all times. In addition to this private telephone system, independent connection is had with the lines of the Southern Bell Telephone & Telegraph Company at the power station, as likewise at the transmission-line branch-off tower at Bibb and at the company's substations in different cities; so that the prospects of total interruption in telephone service are very remote.

SUBSTATIONS.

The substation buildings are all of brick and steel construction with concrete floors and foundations. The roofs, which are of timber with tar and gravel covering, are carried on steel trusses and are surmounted by steel towers for receiving the incoming high-tension lines from the power house, which is equipped with electrolytic lightning arresters separated from the lines under normal conditions, by horn gaps.

Four sixty-cycle, 1,500-kilovolt-ampere single-phase, oil-insulated water-cooled transformers are installed in the Macon substation and have voltages as follows: High tension, 36,400, 34,600; 32,900 volts delta; 63,000, 60,000, 57,000 volts star; and low tension, 6,900, 6,600, 6,300 volts delta. The transformers mentioned are fitted with relief valves. The transformers in the Griffin station are four sixty-cycle, 750-kilovolt-ampere instruments of the same type.



FORSYTH SUBSTATION.

All the oil-insulated water-cooled transformers are mounted in boiler-iron tanks which are fitted with wheels to facilitate moving the transformers. The transformers are all of the shell type. The brass cooling coils will safely stand 250 pounds per square inch.

In the Forsyth substation there are

four sixty-cycle, 200-kilovolt-ampere single-phase oil-insulated self-cooled transformers of the core type. The high-tension side is wound for 36,400 volts and insulated for star connection to give 63,000 volts; the low-tension is wound for 6,900 volts. The transformer is mounted in a case with a corrugated sheet-steel wall with welded seams, cast into top and bottom castings.

The high-tension lines are carried through the roof by the medium of porcelain insulator terminals set on concrete cones, thence through disconnecting switches to high-tension oil switches located on the floor opposite the transformers. A bus tie line connects the two feeder lines through disconnecting switches with the above disconnecting switches; the lines passing through the busbars, through the oil switch to the outgoing feeder lines, which are protected by electrolytic lightning arresters similar but smaller than those installed on the high-tension lines.

As in the main power station, a transformer truck runs the length of the building between the transformers and switchboard immediately opposite.

Only three transformers are, of course, used in any of the stations, the fourth being reserved for emergency. Provisions have been made for each station whereby an additional bank of transformers of corresponding capacity may be installed and it is understood that this will be done in the very near future.

DISTRIBUTION.

The company being distinctly a wholesaler of power, service is delivered to its customers at a pressure of 6,600 volts, and is measured and paid for accordingly. The consumer in all cases constructs a small brick or concrete compartment for the accommodation of his transformers and protective devices. For the purpose of standardization of such installations, as likewise to conserve the mutual interests of the consumer and the company, the latter has drawn up a standard set of specifications setting forth the company's recommendations as to the general character of and the minimum apparatus which the consumer should install in his transformer station, copies of which specifications are furnished to the prospective consumer together with plans showing suggested design of the station and layout of apparatus therein.

In the case of large power users, a consulting engineer is usually retained by the consumer, but in the case of the smaller consumers of power, who do not or cannot afford to retain an engineer, the company lays out the work. The company retains skilled engineers, who are always available for this purpose and also to aid consumers whenever they may have trouble with any of their electrical equipments.

The market for power in Central Georgia is a very fertile one. Outside of this fact, the business offered is of a much more desirable nature than that obtained in many other localities; that is to say, whereas in many sections of the South, the power business consists entirely of cotton mills, in others, furniture factories, in others, knitting mills, etc., the business in Central Georgia is of a diversified nature consisting of cotton mills, knitting mills, cotton-seed oil mills, wood-working mills, railway plants, fertilizer plants, breweries, flour mills, brick plants, packing plants, etc. As can be readily appreciated with this varied class of business offering, the company is in a position to build up a very enviable load-factor.

An important feature about the development is the fact that although the plant has only been in operation about six months, contracts have already been written for upwards of 10,000 horsepower of electrical energy, most of which is already connected and being served from the system. Indeed it is expected that before the end of the present year, the business written will require the installation of the two remaining generators in the power house and doubling of the transformer capacity in the different substations.

Lockwood, Greene & Company, of Boston, Mass., were the consulting engineers, while J. G. White & Company, of New York, were the supervising engineers. The general manager of the company is J. J. Cagney, and many of the special engineering features were his. The company was systematized throughout by Mr. Cagney, and it is stated that its organization is an example of efficiency in every one of its departments.

Electric and Gas Lamps in Germany.

According to the statement of General Secretary G. Dettmar before the recent convention of the German Society of Electrical Engineers, held at Munich, there are 50,000,000 incandescent lamps in use in Germany and 2,000,000 arc lamps, while there are only 25,000,000 gas lamps.

A STUDY OF THE CURRENT TRANSFORMER.—I.

BY P. G. AGNEW.

INTRODUCTION.

In an ideal current transformer the currents would have a ratio equal to the inverse ratio of turns, and the reversed secondary current would be exactly in phase with the primary current. In the actual transformer neither of these conditions is realized, since an appreciable part of the primary current is required to excite the core. Hence, the ratio of the primary to the secondary current is greater than the inverse ratio

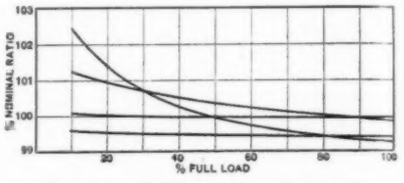


FIG. 1.—TYPICAL RATIO CURVES.

of turns, and the two currents are not quite in phase but differ by a small angle. A further complication is introduced by the fact that the flux-density, and therefore the core loss and magnetizing current, are functions of the current, so that in general, both ratio and phase angle are different for different values of the current load. Moreover, the impedance of the instruments connected with the secondary determine, in part, the value of the flux, so that the whole ratio-current curve may be changed by an increase or decrease in the impedance connected with the secondary.

Fig. 1 shows some typical forms of the ratio-current curves of current transformers, the ordinates being the ratios

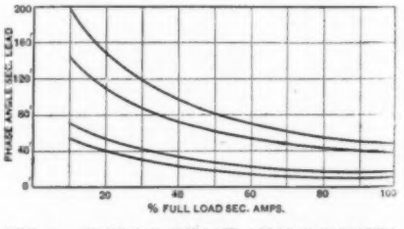


FIG. 2.—TYPICAL PHASE-ANGLE CURVES.

(primary to secondary) expressed in per cent of nominal values. Fig. 2 shows a few typical phase-angle curves, the ordinates being the angles by which the reversed secondary current leads the primary. These curves, as well as those for the ratios, are plotted from actually determined values.

It will be seen that both the ratio and the phase-angle curves tend to become horizontal straight lines near full load, and that they rise more rapidly toward the low-current end of the curve. It is an interesting fact that both types of curves should be so very similar in their general shape.

Although during a considerable experience in the testing of transformers it had been noticed that many transformers showed a tendency to turn down instead of up at the extreme low-current end of the ratio curve, these cases had been passed over with the idea that they were probably due to inaccuracies of measurement, since the difficulties in

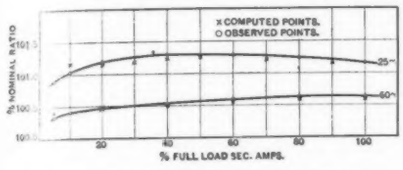


FIG. 3.—RATIO CURVES OF TRANSFORMER F.

making measurements of high accuracy at currents below about twenty per cent of full load are very great. However, Fig. 3 shows the 25 and 60-cycle ratio curves of a transformer exhibiting unusual and remarkable characteristics. It will be seen that at sixty cycles with the small impedance load used, the ratio increases with increasing current throughout the entire range from five per cent of rated load to full load. At twenty-five cycles the ratio increases with increasing current from the value at low-current load to a maximum at approximately half load and then gradually decreases to full load.

In the sixty-cycle curve, the total change in the ratio from ten per cent

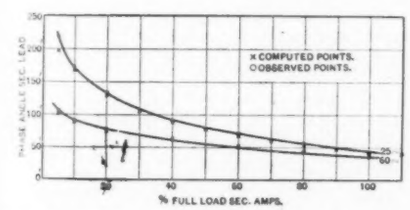


FIG. 4.—PHASE-ANGLE CURVES OF TRANSFORMER F.

to full load is 0.23 per cent, a quantity about ten times as great as the sensibility of the method used, if averaged over the whole range. The experimental evidence that the twenty-five-cycle curve passed through a maximum was equally good. The direct determinations are indicated by circles, all lying on the curves in Fig. 3. The points indicated by crosses are computed values which will be discussed later. It seemed important to determine, if possible, whether there might be theoretical errors in the method of measurements used, or, if not,

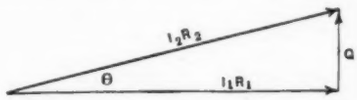


FIG. 5.—VECTOR RELATIONS IN METHOD OF MEASURING RATIO AND PHASE ANGLE.

whether some light might not be thrown upon the nature of the iron losses at such low flux-densities as are used in current transformers, and upon their possible effect on the ratio and phase angle of the instruments.

METHODS FOR DETERMINING RATIO AND PHASE ANGLE.

The most accurate methods for the measurement of ratio and phase angle are null methods, depending upon the potentiometer principle. The electromotive forces at the terminals of two non-inductive shunts placed in the primary and secondary, respectively, are opposed; and the resistance of the secondary shunt is adjusted until the in-phase component of the resulting electromotive force is zero. The current relations are shown in Fig. 5, where $I_1 R_1$ and $I_2 R_2$ are the electromotive forces, θ the phase angle, and Q the quadrature component of the resultant electromotive force.

The method in use at the Bureau of Standards is to place the series coil of an electrodynamometer in series with the primary shunt, and use the moving coil as a detector for setting the in-phase component of the resultant at zero.[1]

[1]For a complete description of this method together with a derivation of the equations, see Agnew and Fitch, *Bulletin of Bureau of Standards*, 6, p. 292, 1909; Reprint No. 130.

Orlich[2] has described a similar method in which a sensitive electrometer is used as the detector instead of the electrodynamometer.

Robinson[3] has developed a rotating commutator with which he uses a direct-current galvanometer as a detector in place of an electrometer or an electrodynamometer. This commutator is driven by a synchronous motor and rectifies the quadrature component Q so that it may be measured by means of a direct-current galvanometer with all the requisite sensibility. The form-factor enters into the reduction of the results.

This rotating-commutator method has been further developed by Sharp

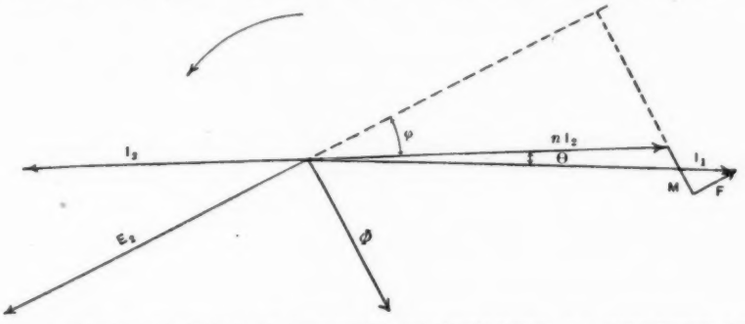


FIG. 6.—VECTOR DIAGRAM OF CURRENT TRANSFORMER ON INDUCTIVE LOAD.

and Crawford,[4] who have also used a mutual inductance in the secondary to reduce the measurement of the quadrature component Q to a null method. They have also suggested a method of using a mutual inductance instead of the shunts in primary and secondary circuits.

CALCULATION OF RATIO AND PHASE ANGLE.

Fig. 6 is a vector diagram of the current transformer. If we let

Φ = flux,
I_1 = primary current,
I_2 = secondary current,
E_2 = secondary electromotive force,
n = ratio of turns of secondary to turns of primary,
ϕ = phase angle of secondary circuit,
θ = phase angle of transformer,

FIG. 7.—VECTOR DIAGRAM OF CURRENT TRANSFORMER ON NONINDUCTIVE LOAD.

M = magnetizing current,
F = core-loss component of exciting current,
R = ratio of currents,

then we may consider that the flux Φ induces the electromotive force E_2 in

[2]*Elektrotechnische Zeitschrift*, 30, p. 468; 1909.
[3]*Trans. Amer. Inst. Elec. Eng.*, 28, p. 1005; 1909.
[4]*Proc. Amer. Inst. Elec. Eng.*, 29, p. 1207; 1910.

the secondary, giving rise to I_2 in the secondary and requiring a component in the primary opposite in phase and equal to $n\,I_2$ in magnitude.

But in order to maintain the flux the primary also has to furnish a magnetizing current M in phase with the flux, and a core-loss current F opposite in phase to E_2. Hence, the total primary current is made up of $n\,I_2$, M, and F, taken in proper phase relations.

By projecting the vectors on the line $n\,I_2$ and also perpendicular to it, it may be shown that with a close degree of approximation

$$R = n + \frac{M \sin\phi + F \cos\phi}{I_2} \qquad (1)$$

and

$$\tan\theta = \frac{M\cos\phi - F\sin\phi}{nI_2} \qquad (2)$$

In case the load is non-inductive,

$$\sin\phi = 0 \text{ and } \cos\phi = 1$$

and (1) and (2) reduce to the forms

$$R = n + F/I_2 \qquad (3)$$

$$\tan\theta = M/n\,I_2 \qquad (4)$$

and the vector diagram takes the simple form shown in Fig. 7, from which it is seen that the magnetizing current M will determine the phase angle, but has very little effect upon the ratio, while the core loss will determine the ratio, having practically no effect upon the phase angle.

The core-loss current, the magnetizing current and the total exciting current at twenty-five cycles for transformer F are shown in Fig. 9, and the same quantities for a frequency of sixty cycles in Fig. 10. These were measured directly by a special method, the field coil of a dynamometer being excited by a current whose phase was adjustable, while the electromotive force at the terminals of a shunt through which the exciting current passed was applied to the moving coil. This allowed each component of the exciting current to be measured separately.

The ratio and phase angle were computed from this data and the results are indicated by the crosses in Figs. 3 and 4. The core losses at both twenty-five and sixty cycles are plotted in Fig. 8. The following are the constants of the transformer.

CONSTANTS OF TRANSFORMERS.

Number primary turns 25.
Number of secondary turns 196.
Rated currents 40 and 5 amperes.
Secondary resistance 0.51 ohm.
Resistance of connected load 0.17 ohm.
Inductance of connected load 0.08 millihenry.
Maximum flux at 60 cycles, 290 maxwells.
Maximum flux at 25 cycles, 700 maxwells.

It will be seen that the agreement between measured and computed values is very good, especially in the case of the sixty-cycle curve, where the conditions are more favorable. The greatest discrepancy in the range from tenth to full load is but one part in three thousand. Of course, the possibility of the same error entering into both measurements is to be considered, as, for example, errors due to wave distortion.

A check measurement of the ratio by an entirely different method was made, using the Northrup hot-wire comparator as a transfer instrument by which the ratio of the two currents was referred to the ratio of the readings of two potentiometers on direct current.

The average of ten measurements gave the same ratio to the last figure (one part in eight thousand) at full load as was found by the two-dynamometer null method. It is very difficult to see how

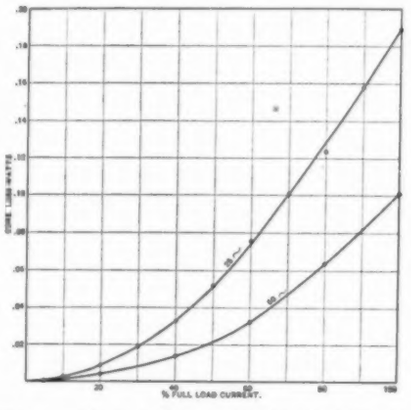


FIG. 8.—CORE LOSS OF TRANSFORMER F.

the same error could enter into two such radically different methods of measurement, and as it will be shown that the distortion is negligible, it must be concluded that the forms of ratio curves found for transformer F are correct.

But so close an agreement between observed and computed values indicates that there must be some simple theoretical connection between the nature of the iron losses and the slope of the ratio curve.

CONDITIONS FOR LINEAR RATIO AND PHASE-ANGLE CURVES.

Such a relation may easily be shown to exist if we assume that the *total* iron losses may be expressed in the Steinmetz form

$$W = KB^c \qquad (5)$$

where

W = total iron loss in watts,
B = maximum flux-density,
c, K = constants for a given transformer at a given frequency.

If c be assumed to be rigorously constant, it can be shown that the ratio will increase with increasing secondary current when c is greater than 2, and it will decrease with increasing current when c is less than 2, provided the secondary circuit is non-inductive. For by (3)

$$R = n + F/I_2$$

where F is the core-loss component of the exciting current and the term F/I_2 represents the departure from the ratio of turns. Both the current and the voltage may be taken as proportioned to the maximum flux. If E_2 is the secondary voltage, then since F is measured in the primary and E_2 in the secondary we have

$$F = n\,W/E_2$$

and

$$I_2 = BK_1$$

Therefore

$$\frac{E}{I_2} = \frac{nW}{K_1BE_2} = \frac{nW}{K_1BK_2B} = \frac{nW}{K_1K_2B^2} \qquad (6)$$

Hence from (5) and (6)

$$\frac{F}{I_2} = \frac{nKB^c}{K_1K_2B^2} = K_3B^{c-2}$$

$$R = n + K_3B^{c-2} \qquad (7)$$

$$\frac{dR}{dB} = K_3\,(c-2)\,B^{c-3}$$

But again, since I_2 is proportional to B,

$$\frac{dR}{dI_2} = K_4\,(c-2)\,B^{c-3} \qquad (8)$$

This will be positive if c is greater than 2, and negative if it is less than 2. Hence, if the exponent c for the total iron losses is equal to 2, the ratio curve becomes a horizontal straight line. If we assume the eddy-current loss to vary as B^2, then the same conclusions will apply to the hysteretic exponent alone.

Some interesting relations connecting the shape of the ratio curve with the exponent, if the latter be treated as a constant, may be brought out by a development of equation (8). Since the flux may be taken as proportional to the current this may be written

$$\frac{dR}{dI_2} = K_5\,(c-2)\,I_2^{\,c-3}$$

To get the curvature we should, strictly, differentiate this with respect to the length of the curve, but since the curve is nearly horizontal we may, for approximate values, differentiate in respect to I_2 instead.

$$\frac{d^2R}{dI_2^2} = K_5\,(c-2)\,(c-3)\,I_2^{\,c-4}$$

So that we have

Ratio $= n + K\,I_2^{\,c-2}$
Slope $= K\,(c-2)\,I_2^{\,c-3}$
Curvature $= K\,(c-2)\,(c-3)\,I_2^{\,c-4}$

From the last of these equations it may

be seen that the ratio curve will be a straight line (zero curvature) only when

$$c = 2 \text{ or } c = 3.$$

The matter is summarized in the following table.

TABLE I.

Exponent.	Slope.	Curvature.	Ratio Curve.
$c < 2$	—	+	Slopes down; concave up
$c = 2$	0	0	Horizontal straight line
$2 < c < 3$	+	—	Slopes up; concave down
$c = 3$	+	0	Slopes up; straight line
$c > 3$	+	+	Slopes up; concave up

The first case is the usual one, well illustrated by the typical curve of Fig. 1. While the straight line of the second case has never been completely realized, it is approached very nearly in some high-grade transformers with low impedance load (compare the lower curve of Fig. 1). The third case of an upward sloping curve, concave downward, is illustrated by the sixty-cycle curve for transformer *F* (Fig. 3). Neither of the last two cases has ever been observed.

The simple theory as here outlined for a constant exponent is unable to account for a case in which the ratio passes through a maximum, as is the case with the twenty-five-cycle curve for transformer *F* (Fig. 3). The slope of this curve will be computed from the results of a more general treatment which will be given later.

It is seen from the factor I_2^{c-4}, which enters the expression for the curvature, that the curvature will in general decrease with increasing current. The typical ratio curve (see Fig. 1) slopes down, is concave up, and the curvature decreases with increasing current, all of which are predicted by theory for the case of an exponent less than 2.

While the case of an assumed constant exponent thus agrees qualitatively with the experimental facts, it is quantitatively insufficient for precise measurements. Moreover, a more serious difficulty lies in the determination of the exponent when the latter is not a constant, and the variation is greater at the low flux-densities used in the current transformer.

THE SLOPE OF THE RATIO CURVE DETERMINED BY THE RATIO OF VARIATION.

It has become usual to consider the Steinmetz exponent as varying slightly, as it is well known that the simple equation with a constant exponent will not accurately represent observed values. But it has been pointed out in a previous article that unless the exponent is actually constant the methods for determining it fail to give an exponent at all, the quantity actually given by these methods being the slope of the curve obtained by plotting *W* against *B* on logarithmic paper, and the suggestion has been made that this quantity should be

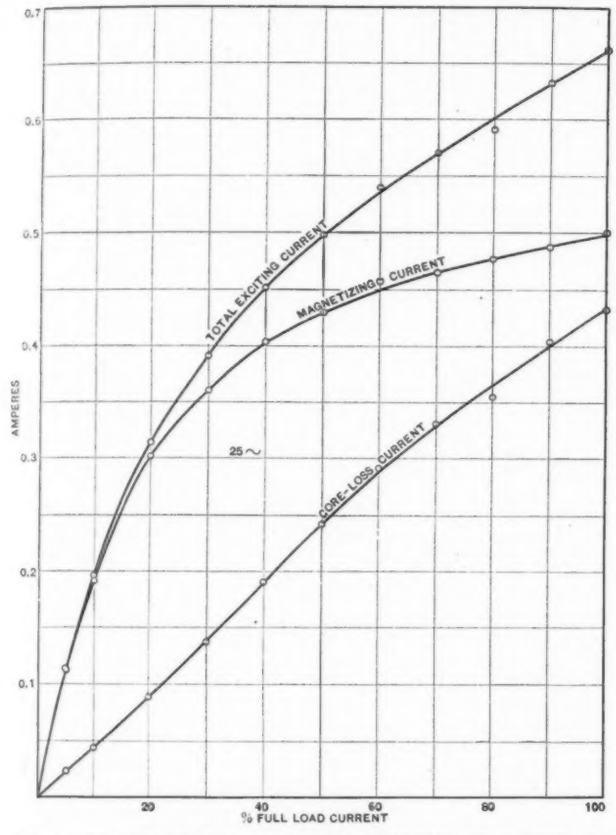


FIG. 9.—COMPONENTS OF EXCITING CURRENT AT 25 CYCLES. TRANSFORMER F.

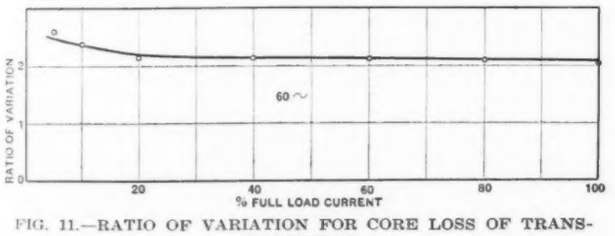


FIG. 11.—RATIO OF VARIATION FOR CORE LOSS OF TRANSFORMER F.

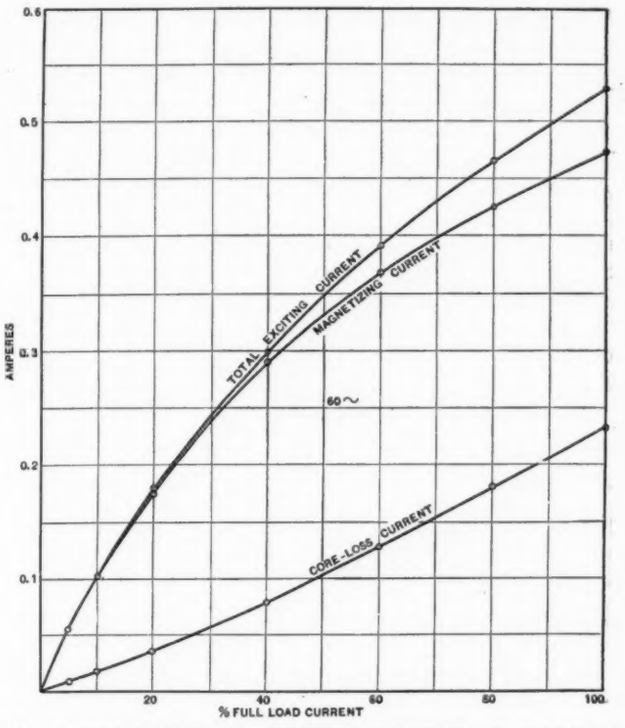


FIG. 10.—COMPONENTS OF EXCITING CURRENT AT 60 CYCLES. TRANSFORMER F.

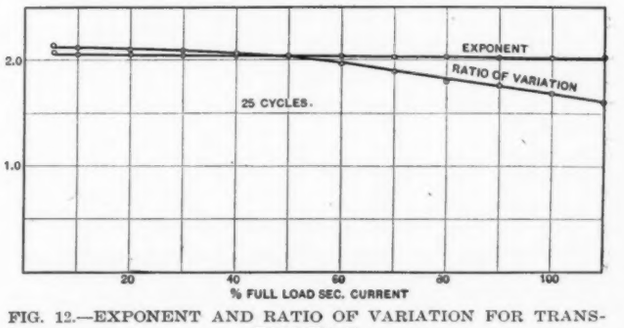


FIG. 12.—EXPONENT AND RATIO OF VARIATION FOR TRANSFORMER F.

called the "ratio of variation," since it is the ratio of the percentage change in W due to a percentage variation in B. (See ELECTRICAL REVIEW AND WESTERN ELECTRICIAN for July 15, page 114.) The ratio of variation and the actual exponent may have very different values in actual cases, but are identical when the exponent is constant.

The previous statement of the dependence of the slope of the ratio curve upon the value of a constant exponent holds in exactly the same way for the general case of a variable exponent if the ratio of variation be substituted for the exponent. In fact, the development may be made without assuming any empirical relation between the flux and the total loss. By equation (3)

$$R = n + F/I_2$$

where R is the ratio, n is the number of turns and F the core-loss component of the exciting current. If W is the core loss, E_1, E_2 the primary and secondary voltages, and r_2 the secondary resistance, then

$$F = W/E_1 = nW/E_2 = nW/r_2I_2 \quad (9)$$

and the ratio becomes

$$R = n + nW/r_2I_2^2$$

Differentiating,

$$\frac{dR}{dI} = \frac{n}{r_2}\,\frac{\frac{dW}{I_2dI_2} - 2W}{I_2^2} = \frac{nW}{r_2I_2^2}\left(\frac{\frac{dW}{W}}{\frac{dI_2}{I_2}} - 2\right)$$

Replacing F from (9)

$$\frac{dR}{dI} = \frac{F}{I_2^2}\left(\frac{\frac{dW}{W}}{\frac{dI_2}{I_2}} - 2\right) \quad (10)$$

The fraction within the parenthesis is the ratio of variation of the core loss with respect to the current, but since the current is proportional to the flux, this is the same as the ratio of variation with respect to the flux. Hence we may also write

$$\frac{dR}{dI} = \frac{F}{I_2^2}\left(\frac{\frac{dW}{W}}{\frac{dB}{B}} - 2\right) \quad (11)$$

Either (10) or (11) shows that the ratio of a current transformer will rise with increasing current when the ratio of variation is greater than 2, and that it decreases with increasing current when the ratio of variation is less than 2. This latter is, as already stated, almost universally the case.

That the experimental results obtained from the measurements of transformer F verify this conclusion may be seen from a comparison of the ratio curves of Fig. 3 with the curves of the ratio of variation of Figs. 11 and 12. At sixty cycles the ratio curve slopes upward throughout its length, and in agreement with this the ratio of variation is greater than 2 over the whole range. In the curve at twenty-five cycles the ratio increases to half load and then slowly decreases to full load, while in agreement with this the ratio of variation is greater than 2 for low currents and less than 2 for the larger currents, passing through the value 2 at approximately half load.

To test equation (10) quantitatively Table II has been computed for this transformer from the quantities plotted in the figures referred to.

TABLE II.—SLOPE OF RATIO CURVE, IN PERCENTAGE CHANGE OF RATIO PER AMPERE.

Secondary Current.	60 Cycles. Calculated.	60 Cycles. Observed.	25 Cycles. Calculated.	25 Cycles. Observed.
1	+0.09	+0.09	+0.27	+0.09
2	+ .06	+ .04	+ .04	+ .04
2.5			.00	.00
3	+ .05	+ .03	— .02	— .02
4	+ .02	+ .02	— .07	— .05
5	+ .01	+ .01	— .09	— .07

With the exception of the value for one ampere at twenty-five cycles the agreement is extremely satisfactory. The discrepancy at the one point is due to the great difficulty in obtaining sufficiently accurate determinations of both the ratio and the core loss at the low loads. In fact, the agreement at one ampere and sixty cycles must be regarded as accidental.

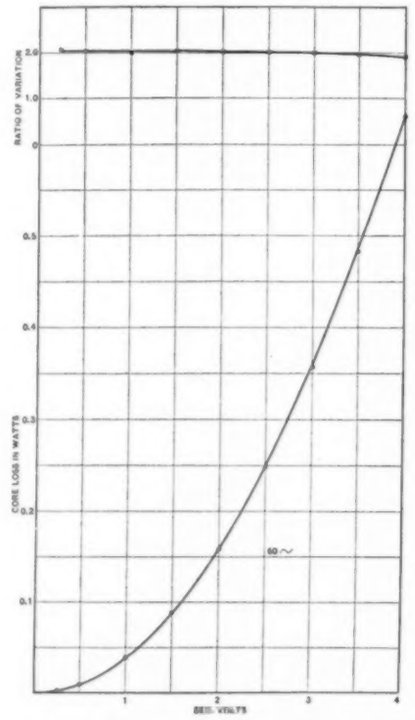


FIG. 13.—CORE LOSS AND RATIO OF VARIATION FOR TRANSFORMER G.

In Fig. 13 the loss and the ratio of variation for the core of a power transformer, designated as transformer G, are plotted for low flux-densities, the maximum value reached being 235 gausses. The ratio of variation decreases from slightly over 2 at low voltage to slightly less than 2 at the highest voltage shown. When tested as a current transformer it gave a very flat curve as would be predicted from theory, and actually passed through a maximum; but the change in ratio was only a very few hundredths of a per cent.

A few other cases have been found in which the ratio of variation was slightly greater than 2 at low flux-densities, but no other case has been found in which the phenomenon of the ratio of transformation increasing with the current was anywhere nearly as pronounced as with transformer F.

(To be continued.)

The Electrical Section of the Bureau of Mines.[1]

The electrical section of the Bureau of Mines was organized in 1909 to investigate the conditions under which electricity is used underground, in order to obtain data that will be of assistance to those state officials who have charge of the regulation and inspection of mines and to all who use or manufacture electrical mining equipment. The section is part of the mining experiment station of the Bureau at Pittsburg, Pa.

It is the purpose of the section to attempt to discover the causes of accidents from the use of electricity in mines and to suggest means for the prevention of such accidents; to make tests of the safety of electrical equipment under conditions most conducive to disaster; and to make such tests of a general nature as bear upon the safety of electricity in mines, accidents attributed to electrical causes, etc.

Although the function of the section is to investigate and test rather than to develop, facts that will be of value to those designing equipment are continually being learned in the process of testing and are always at the disposal of interested persons.

Bulletins will be issued from time to time describing the tests made and the results obtained. The section is always ready to discuss, by correspondence or by conference at the Pittsburg station, the problems relating to accidents caused by electricity, the results of

1 From Technical Paper No. 4 of the Bureau of Mines, by H. H. Clark.

tests, or the means and methods of safeguarding underground electrical equipment.

The laboratory is provided with a six-panel switchboard for the control of transformers, generators, and circuits; a complete equipment of alternating-current and direct-current voltmeters and ammeters; an outfit for measuring insulation resistance up to 80,000 megohms; a five-kilowatt high-potential testing transformer, the voltage of which can be gradually varied up to 30,000 volts; a Wheatstone bridge; rheostats; and miscellaneous tools and supplies.

There are two galleries for testing electrical equipment in the presence of gas. The larger testing gallery is a tube designed to represent a short section of a mine entry. It is erected outside the laboratory and consists of a cylindrical shell of boiler iron 30 feet long and 10 feet in diameter, laid horizontally upon a concrete bed and partly filled with concrete to form a floor upon which apparatus can be set up for test. At 7.5 feet from either end, the cylinder can be stopped off with diaphragms of heavy paper, which relieve the pressure from explosions before it becomes dangerously heavy. After the diaphragms are in place the gallery can be entered through a manhole cut in the side of the shell between the heads. Heavy plate-glass windows are set in the sides of the gallery.

A large motor-driven centrifugal fan mixes and circulates the gas and air, and a special device has been developed to indicate the percentage of gas in the mixtures. Tests of explosion-proof motors, explosion-proof switches, and other large apparatus are made in this gallery.

A gallery or testing tube for investigating the ignition of coal dust by electricity is now being designed and will be constructed shortly. This gallery will be similar in most respects to those already described, but will differ in a few details.

The Bureau has made a few preliminary investigations, the most important of which are an investigation as to the danger of gas ignition by the indicators of inclosed fuses, and an investigation as to the danger of gas ignition by incandescent lamps when broken in gaseous atmospheres. The preliminary investigation showed that certain sizes of incandescent lamps, when broken, ignite surrounding explosive mixtures of gas and air. The tests now under way will determine the factor of safety of such lamps as have not caused ignition in previous experiments.

In making tests of incandescent lamps they are placed in a gas-tight receptacle filled with a mixture of gas and air combined in proportions most sensitive to ignition. The lamps are lighted and the filaments are brought into contact with the gaseous mixture in three ways, as follows:

(a) By smashing the bulbs completely, which brings the mixture in contact with broken filaments.

(b) By snipping off the tips, which usually does not break the filaments, as the velocity of the entering gas is less than in (a).

(c) By puncturing a small hole in the necks of the bulbs, which prevents the entering gas from impinging directly upon the filaments and therefore rarely breaks them.

Such lamps as do not ignite the mixtures under normal conditions are further tested by increasing the temperature of their filaments until explosion follows the breaking of the lamps. A comparison of the excess energy required in any case gives a good indication of the relative safety of the lamp.

Explosion-proof switches and explosion-proof motors are tested in the same way, as the flame-proof quality of the casings is in each case the point at issue.

In testing explosion-proof apparatus the casings are completely filled with various mixtures of gas and air and completely surrounded by a mixture of the same constituents combined in proportions most sensitive to ignition. The mixture within the casing is exploded by an electric spark, and the character and extent of the discharged flames, and their action upon the surrounding gas, are noted.

TESTS OF INCLOSED CARTRIDGE FUSES IN EXPLOSIVE GAS.

As a part of the investigation of the causes of mine explosions, authorized by Congress in May, 1908, the Secretary of the Interior decided that a careful examination should be made of the various inclosed electric fuses used in mining operations with a view to determining how far these fuses, when installed for service in gaseous atmospheres, might be responsible for the occurrence of disasters.

With this in view, a letter was sent by the Director of the United States Geological Survey on July 8, 1909, to the manufacturers of fuses in the United States, setting forth the conditions under which such fuses would be examined and the nature of the tests to which they would be subjected.

In response to this communication, applications were received from seven different manufacturers, who submitted samples of their product for test. The fuses tested were standard N. E. C. cartridge fuses of the indicator type, varying in size from 30 amperes, 250 volts, to 100 amperes, 600 volts.

There are two elements of danger attending the action of such fuses in the presence of inflammable mixtures of gas and air, namely: (a) the action of the indicators located on the external surface of the shell; these, when the fuse acts, may, by giving out sparks or otherwise, ignite the explosive mixture; (b) the blowing of hot gas and jets of flame through the relief ports of the fuses by the energy released within the shell.

The generating capacity available for making the tests was sufficient to test only the indicators of the fuses to a satisfactory limit. Although, therefore, the tests proved the dangerous character of the indicators, they can not be considered conclusive as to the safety of the relief ports. The available generating capacity also limited the tests to fuses having a capacity of 100 amperes or less in both 250 and 600-volt sizes. The conditions were about as severe as those in a large percentage of the mine installations of the present day.

Seven different brands of fuses were tested. All made use of a fine wire which was burnt off when the fuse acted. The details of the indicator devices are given below.

Brand No. 1.—The indicating wire of this brand was led through a pinch of inflammable powder placed upon the outer surface of the shell and covered by a paper label. When the fuse acted the burning of the indicator wire ignited the powder, which burned a hole in the paper.

Brand No. 2.—The indicator of this brand was similar to that of brand No. 1, but had more powder under the paper label.

Brand No. 3.—The indicating wire of this brand was led across a circular white paper dot placed upon the outer surface

of the shell. The wire was covered by a paper label except where it crossed the dot. When the fuse acted the wire burned off and left the dot clear.

Brand No. 4.—The indicator of this brand was similar to that of brand No. 3, but the indicator wire was led under the paper dot which, when the fuse acted, burned and exposed the shell of the fuse.

Brand No. 5.—The indicating wire of this brand was led through a small quantity of inflammable material held in a little hole in one of the brass caps. When the fuse acted this material burned and left a black spot upon the brass cap.

Brand No. 6.—The indicating wire of this brand was led through an explosive wad sunk into the fuse shell and covered by wire gauze and a disk of leather or similar material. When the fuse acted the disk was blown out of place.

Brand No. 7.—This brand had two types of indicators, both of which depended upon the action of a spring released by the burning of the indicator wire.

The fuses were mounted in standard clips or holders and placed inside a gas-tight, boiler-iron box that measured 24 by 18 by 18 inches. This box was provided with means for admitting any desired percentage of gas. The electrical connections were so made that by throwing a single switch the full potential of 250 or 600 volts was thrown directly across two fuses in series.

The results of the tests are summarized in the table.

RESULTS OF TESTS OF INCLOSED CARTRIDGE FUSES.

Brand No.	Number of tests.	Number of explosions.	—Cause of Explosion— Undetermined.	Indicator.	Blowing at port.	Percentages of explosions.
1	24	10	1	3	6	41.6
2	23	12	..	12	..	52.2
3	32	24	..	24	..	75.0
4	24	5	..	5	..	20.8
5	20	13	..	13	..	65.0
6	21	1	..	..	1	4.7
7	32	1	..	1	..	3.1

The conclusions from the results of these tests are as follows:

(1) One or more sizes of all the brands of fuses tested ignited the gas, although in varying degrees. Two brands ignited the gas but once; three brands ignited it in more than fifty per cent of the trials.

(2) The principal source of danger in fuses as they are now designed is the device for indicating whether or not a fuse has acted.

(3) Danger from blowing at the relief ports will probably develop in some and possibly in all brands if tested with enough generating capacity.

LETTER TO THE EDITOR.

Public-Corporation Accounting.

To the Editor:

Your editorial on "Evidence before Public-Utility Commissions," which appeared in your issue of June 17, is a very timely one and ought to suggest to managers of public-service corporations the absolute necessity of a proper system of accounting. A purely commercial set of books is out of place because the business of all such corporations is of an industrial nature and demands special accounting.

I will not here attempt to discuss all the advantages of such an accounting but wish to refer to it merely as the only true and reliable evidence that will be helpful to public-utility commissions in establishing just rates.

The practice of supervising and controlling public-service corporations by public-utility commissons has come to stay, and I am glad to state that wherever established they have always acted in a spirit of fairness towards the consuming public and also towards the corporation. They have never supported the often erroneous contention that rates must be lowered when the public think such rates are excessive. This would be resorting to practices of politicians. On the contrary, they want to investigate the matter for their own satisfaction; they have the power to examine witnesses as well as books and records in order to come to the right conclusions.

If a corporation can show through its capital investment account the original cost of its physical assets; if it can produce through a properly kept construction account and its vouchers conclusive evidence as to the cost of new constructions; if it has kept separate maintenance and operating accounts and thereby is able to show actual cost of maintaining its plant, rolling stock, pipes, wires, etc., in proper physical condition, as well as cost of producing and delivering their commodities (be they water, light, heat, telephone, transportation, etc.) to the consuming public, if all such accounts are controlled by and provable through its financial accounts, why then the commission has at its command the most reliable data which it is possible to obtain.

If, on the other hand, such books and records cannot be produced, resort must be had to estimating. This means the employment of expert accountants, engineers, etc., and proves in the end rather expensive to the corporation. And while such estimates may be very accurate and scientifically correct, and mostly based upon results obtained from the operation of other similar plants, still they are not real, when it comes to the corporation whose rates are under investigation.

Another most serious consideration for corporations of the latter class will be the problem to conduct the management of their plants under conditions that will make the established new rate profitable. The fact of the matter is that these corporations have drifted away from efficient and scientific management, they have fallen into a certain rut, their help is inefficient, their clerks are without knowledge of up-to-date methods, and every man well posted in such matters knows what it means to remedy such matters.

My advice to every such corporation that conducts its business in such a way would be to get some one firm of accountants to systematize their accounting methods, or still better, put their office in charge of an experienced bookkeeper who is familiar with industrial accounting, for he will not merely install such a system; he will also be with them and conduct it for them. It must always be remembered that a good system in charge of an inexperienced man will be like a modern tool in the hands of a savage; it will be of no account.

A. C. Fieguth.

Hoosac Tunnel Inspection.

The Boston & Maine Railroad took a party of about two hundred newspaper men of Massachusetts upon an inspection trip to the Hoosac Tunnel on July 11. The distinctive features of the new electrical system were inspected, after which dinner was served at a North Adams hotel. Vice-president Byrnes then pointed out the advantages to the railroad of the electrification of the tunnel. Formerly the capacity of the Fitchburg Division was limited by the tunnel to 800 freight cars a day; now it accommodates 1,600 freight cars, so that electrification has doubled the capacity of the division. The comfort of the passengers was also enormously increased.

W. S. Murray, electrical engineer, explained the methods employed, and said that the new system had proved its efficiency.

CENTRAL-STATION PRACTICE

Transmission—Interior Wiring

ELEMENTS OF POWER-STATION DESIGN.—XXXV.

CONTRACTS AND SPECIFICATIONS.—II.

BY W. B. GUMP.

In the last installment of this series (June 10, page 1174) the salient features that should be incorporated into contracts and specifications for the supply or erection of power-house equipment were discussed, fifteen general precautions being pointed out. The following is a typical set of preliminary specifications supplementary to an advertisement for proposals. They bear out the suggestions of brevity and explicitness in the last section.

SPECIFICATIONS
for
ONE 750-KILOWATT TURBO-GENERATOR UNIT WITH REGULATOR AND EXCITER, TOGETHER WITH SURFACE CONDENSER AND CONDENSER EQUIPMENT; SAME TO BE ERECTED COMPLETE ON FOUNDATIONS PREPARED BY THE CITY OF .....

Generator.—The generator to be furnished with this equipment must be capable of operating at full load of seven-hundred-fifty (750) true kilowatts at eighty-five (85) per cent power-factor for twenty-four (24) hours, with a temperature rise not to exceed forty (40) degrees centigrade, and to operate for twenty-four (24) hours at a one-hundred-twenty-five (125) per cent load at eighty-five (85) per cent power-factor with a temperature rise not to exceed fifty (50) degrees centigrade, and to operate at a one-hundred-fifty (150) per cent load at eighty-five (85) per cent power-factor for a period of one (1) hour at a temperature rise not to exceed sixty (60) degrees centigrade, in either field or armature.

The above specified outputs are to be in true kilowatts at eighty-five (85) per cent power-factor.

Armature Coils. All bidders must include with the generator and exciter twelve (12) per cent extra armature coils for each, to be kept in stock for emergencies. Price on these coils to be quoted separately.

Exciter. The exciter must be able to give at its normal speed sufficient voltage and current to excite the generator when operated at the maximum overload and at fifty (50) per cent power-factor.

Condenser. The condenser is to be of the surface type with cylindrical shell containing 2,400 square feet of cooling surface, consisting of five-eighths (⅝") inch cold-drawn, No. 18 gauge, seamless brass tubes. Same are to be secured in brass tube plates with suitable ferrules and the highest grade packing for this work.

Air Pump. The air pump is to be of the triplex vertical type, electrically driven, and to be of sufficient capacity to handle all water of condensation and deliver same to the hot well, which will be approximately fifteen (15) feet above the bottom of the condenser.

Circulating Pump. The circulating pump to be one of the best designed centrifugal type and of sufficient capacity to deliver ample circulating water, taking same at a lift of not more than two (2) feet and delivering same against a head not to exceed forty (40) feet. Same to be electrically driven.

Motors. Motors to be furnished for driving the air and circulating pumps are to be three (3) phase, sixty (60) cycle, four-hundred-forty (440) volts, and are to be of the best design and manufacture. The make of the motors to be optional with the purchaser, that is, the purchaser is to have the choice of the best motors of the above type in the market, and any difference in price of the different makes must be stated in bid.

Connections. The City of ..... is to make connections for supplying steam to the turbine and also to run exhaust pipe from the automatic back-pressure valve, which is to be furnished with the equipment; also, to run all wires for connecting the motors for driving the auxiliary apparatus.

Temperature. The temperature of the injection water during the summer months averages seventy-six (76) to seventy-eight (78) degrees Fahrenheit, and is cooled by means of cooling tower.

Guarantee. Bidders will be required to guarantee water consumption per kilowatt-hour, when operated at a steam pressure of one hundred eighty (180) pounds per square inch at the throttle, carrying a superheat of seventy-five (75) degrees Fahrenheit with a vacuum of twenty-six (26) inches at the exhaust flange.

The generator proposed must not have a lower efficiency than ninety-two (92) per cent at fifty (50) per cent load, ninety-three and one-half (93.5) per cent at seventy-five (75) per cent load, ninety-four and four-tenths (94.4) per cent at one hundred (100) per cent load, and ninety-four and four-tenths (94.4) per cent at one-hundred-twenty-five (125) per cent load.

The equipment proposed is to be complete in every detail, is to be guaranteed free from defective design, workmanship and material for a period of one year from date of acceptance, and is to be turned over to the City in a first-class operating condition.

It is required that the turbine set be operated at least thirty (30) days before acceptance, under the direction of the party furnishing same.

It is not desired to build cooling towers for greater vacuum than twenty-six (26) inches of mercury, therefore, in making efficiency guarantees, it must be based on twenty-six (26) inches of mercury.

Inspection. All apparatus, materials and workmanship shall be of the best quality and shall be subject to inspection and approval of the general manager of the Municipal Lighting Works Department, who shall have the right to reject any apparatus, materials or work which, in his opinion, do not come up to the requirements of these specifications.

Said manager shall have control as to the interpretations of drawings and specifications.

The following specifications, while not relating to electrical equipment, nevertheless illustrate the general features that should be incorporated into all final specifications and the considerable detail necessary in specifying the piping of any power station.

SPECIFICATIONS
for a
POWER AND HEATING PLANT.

GENERAL PROVISIONS.

1. The Work to be Done consists in furnishing all material, labor, transportation, tools, scaffolding, blocking, apparatus, and utensils necessary for building a Steam Power, Lighting, Heating and Ventilating Plant, and erecting same in the Owner's premises at ..... Street, ..., as per the following specifications, and the accompanying plans.

2. Terms. The term "Owner" when used herein shall mean....., party of the first part; the term "Architect" shall mean ....., or his representative, ..., Consulting Engineer; the term "Contractor" shall mean ....., party of the second part.

3. Material and Workmanship. All material is to be new and of the best quality, each specially adapted to the services required. The workmanship is to be rapid, thorough, and first-class in every particular. In case any material provided, or any work done, shall prove unsatisfactory to the architect, the Contractor will, on being notified, immediately remove same, and supply in place thereof, other work and material satisfactory to the Architect. The spirit as well as the letter of these plans and specifications is to be observed, in order that a first-class plant in every particular may be secured.

4. Superintendence. At all times during construction and erection the work will be subject to inspection by the Architect, who shall have the power to reject any work not in accordance with these plans and specifications.

5. Further Explanation. In case any part or particular of the work shall be deficient, or not clearly expressed in these plans and specifications, the Contractor will apply to the Architect for additional drawings and explanation, and will carry out the general design as directed by the Architect, in a thorough manner, as part of the contract.

6. Conduct of the Work. The Contractor will conduct his operations so as not to interfere with the work of any other contractor, and will work in harmony with all other workmen on the job. The disposal of his tools and material during erection will be subject to the approval of the Architect. He will remove promptly all debris occasioned by his work, and leave same in neat and finished condition.

7. Work on Building. The Owner will provide space for the apparatus, and access to same, and do all other work on the build-

ing necessary for the proper and complete installation of the work herein contracted for, such as additional brick, carpenter or cement work, supports, braces, cutting and other changes. The Contractor shall, however, at his own cost, build all necessary foundations of concrete and shall make good all damages to material, building, or other property of the Owner, or of other contractors, or to neighboring premises, or to the persons or property of the public, occasioned by the Contractor or his employees in the transportation or erection of the work.

8. Ordinances and Restrictions. The Contractor is to comply strictly with all laws, ordinances and underwriter's rules controlling or restricting this class of work in any way, both as to the method of conducting it and the details of workmanship and design.

9. Changes. Should it prove necessary or desirable to make any changes in, or additions to this work, the Architect may direct same in writing, and a fair and equitable addition to—or abatement from—the contract price shall be made, the amount to be determined by the Architect. Such changes shall not modify the obligations of the Contractor or his sureties in any way.

10. Extras. These plans and specifications contemplate a complete heating and ventilating plant, delivered and erected in place, ready for the intended services. No extras will be allowed except upon the written order of the Architect.

11. Failure or Delay. In case of any failure or delay on the part of the Contractor in the execution of this work, or any part of it, the Owner reserves the right, after having once given five (5) days notice in writing to the Contractor of his intention so to do, to provide other workmen, and to complete the work, deducting the cost and charges thereby occasioned from any sum which may be due the Contractor. In case these costs and charges exceed the amount due the Contractor, then the Contractor shall repay such excess to the Owner.

12. Beginning and Completing the Work. The work is to be begun without delay and prosecuted diligently and continuously. It is to be completed, in accordance with these plans and specifications so as to have at least one engine ready for service by June 1, ———, three engines by July 1, ———, and the work finished in full by September 1, ———, which dates are essential features of this contract. The Contractor will be given access to the building at all reasonable times, and will be allowed reasonable and convenient space and facilities for the execution of his work. He will keep informed as to the progress being made with the construction of the building, and will avail himself of every opportunity to prosecute his work. If he is delayed by reason of any construction not being sufficiently advanced to permit his work to proceed, then the Contractor may be granted an extension of time equivalent to the delay so caused; provided he has made a claim to the Architect for such extension not later than the day following the beginning of such delay.

13. Guarantees. The Contractor guarantees all material and workmanship, and will make any repairs without charge, which may become necessary within one (1) year from acceptance, provided such repairs are —in the judgment of the Architect—due to any defects in the original material, workmanship or design. The Contractor guarantees the efficient and satisfactory operation of each part of the work, as hereinafter specified. He will protect the Owner against claims for unpaid labor and material, alleged infringement of patent rights, injuries, or claims of any nature whatsoever, arising from this contract.

14. Accuracy of Data. The data given herein, and on the accompanying plans, are believed to be reasonably exact, but their extreme accuracy is not guaranteed. The Contractor will examine the location carefully, and take such measurements on the ground as he may need, and will provide a complete plant in working order, ready to do the required service.

15. Questions Arising. Should any questions arise during the progress of the work, at the acceptance of the plant, or regarding settlement, such questions shall be referred to the Architect for decision. Should either feel aggrieved at such decision, said party may appeal to two disinterested parties, one chosen by each party to this agreement, and in the event of the parties so chosen failing to agree, they are to choose a third, the decision of two of said referees to be final and binding upon both parties. Such determination shall be a condition precedent to any right or action. If no such appeal is taken within thirty (30) days, the decision of the Architect shall be conclusive. For such arbitration the said Architect and Referees shall be allowed reasonable compensation, the amount thereof to be paid in equal parts by the parties hereto.

16. Bond. At the Owner's option, the Contractor will, within thirty (30) days from date of contract, give the Owner a satisfactory bond in the sum of one-half the contract price, conditioned on the full and faithful execution of the provisions hereof. Such bond is to remain in full force and effect until one (1) year after acceptance of the work.

SPECIFICATIONS IN DETAIL.

SECTION A-5.—LARGER PIPEWORK AND APPARATUS.

17. General Plans. The work contemplated herein covers the steam, exhaust, feed, drain, blow-off and other necessary pipe connections to four 325-horsepower water-tube boilers; four 400-horsepower high-speed Corliss engines, one air compressor, one sprinkler-system pump, three boiler-feed pumps, four steam-jet vacuum pumps, two oil-burner pumps, two feed-water heaters, one domestic-water heater, kitchen and other apparatus all in accordance with the following specifications, and the accompanying plans. Saturated steam of about 155 pounds pressure will be carried on the boilers, and used in engines and pumps. Exhaust steam will be used for heating feed water, domestic hot water, and in heating system of building. Provision is to be made for supplementing this service with live steam when necessary. Plugged openings for possible future refrigerating machine, brine, ice-water and distilled-water pumps, and reboilers, are to be left in both steam and exhaust mains.

18. High-Pressure Lines. These will be as shown on plans, and will consist of a header extending through boiler and engine rooms, with branches to each engine and boiler, and to heating system through reducing valve. There will also be an auxiliary steam header, with connection to each boiler, and branches to air compressor, boiler feed, and other pumps, oil tanks, lubricating system, etc. All high-pressure lines are to be designed for a working pressure of 160 pounds.

19. Bent Pipe will be used for engine and boiler connection where shown. Same must be accurately and neatly finished, uniform in section, free from buckles, and must satisfactorily withstand a heavy hydraulic pressure shop test before shipment. Radius of bends must not be less than five times the diameter of pipe. To be made of full-weight steel pipe and have tangents at each end as long or longer than diameter of pipe. Joints at both ends of all bends to be made with extra heavy malleable iron or steel flanges.

20. Kitchen Lines. From point shown on plans run a two-inch high-pressure line through one and one-quarter inch pressure reducer to kitchen on fourth floor, and make not exceeding fifteen connections, varying in size from three-eighths inch to one inch, to kitchen utensils. From each of same make drain connections, from three-eighths inch to three-quarter inch in size, through separate approved traps, discharging into one and one-quarter-inch main drain line running to feed-water heaters in boiler room.

21. Exhaust Lines. These will be run under engine-floor as shown, the individual lines from the various engines and pumps combining into one main and running into boiler room to feed-water heaters. Provide branches to heating system and domestic-water heater. Run free exhaust where shown, through back-pressure valve, to exhaust head five (5) feet above roof of pent house, with branches in attic for heating.

22. Separators. Furnish and erect complete four six-inch live-steam separators for engines. All to be of the vertical receiver pattern, of the ————————, or other approved make, with wrought steel shells. Connect drain from each separator to an approved high-pressure steam trap, discharging into two and one-half-inch line running to feed-water heaters. Furnish and erect in exhaust line, where shown, one sixteen-inch horizontal grease extractor of the ———————— or other approved make, with covers and drain to blow-off tanks. Traps and connections to the above to be of the same size as drain openings in separators. All traps to be by-passed.

23. Drip Pockets. Install at end of main header and at riser as shown, drip pockets of approved construction, with two-inch outlets in bottom. Connect each outlet with a two-inch trap of same pattern as described in preceding paragraph. Discharge of traps to go into line to heaters.

24. Heaters and Receivers. Furnish and erect two 600-horsepower size ————————, or other approved cast-iron construction feed-water heaters, each to be provided with automatic water regulator, balanced valve, oil catcher, water column, purifying pans, induction chamber, leveling device, crane for removing head, and traps for drips and drains from oil catcher, and overflow, with connection to blow-off tank. Bottom sheets of heaters, heads and pans, to be of cast iron. These heaters are also to serve as receiving and expansion tanks. Another contractor will bring city water supply to a point within twenty feet of these heaters, and will make all additional connections necessary, such as exhaust feed, drain, return, and overflow lines, and water supply from well-water tank.

25. Domestic Hot-water Heater. Furnish, erect and connect where shown, one———— or equivalent automatic water heater, capable of heating 1,500 gallons of water per hour from 60 to 180 degrees Fahrenheit with exhaust steam at atmospheric pressure. To have adjustable automatic control, and thermometer at outlet. Provide connections to same from main, also air valve, drip to feed-water heaters, and drain to blow-off tank. Another contractor will make water connections. Provide necessary supports.

26. Boiler-feed Pumps. Provide and erect three 7½ x 4½ x 10-inch duplex pressure-pattern boiler-feed pumps, of the ———— or equivalent make, brass fitted throughout. Each to have outside end packed plungers and pot valves of composition, designed for hot water. Steam cylinders to be covered with good non-conducting material and approved lagging. Pumps to have special finish throughout. Provide all necessary oil cups, nickel plated; also pet cocks and wrenches. Pumps to be guaranteed to operate smoothly at any speed from 5 to 60 double strokes per minute.

27. Well Pumping. Furnish and erect in present deep well in boiler room, one approved compressed-air system of deep-well pumping. Furnish and attach necessary air and water lines of standard iron pipe, extending to proper depth in present well, which is 350 feet deep, cased with 12-inch No. 12 double well casing perforated in water sand at several points. This depth to

be such as to insure operation with minimum pressure and maximum economy. Attach to bottom an approved brass strainer. The whole to be capable of delivering at least 180 gallons of water per minute, provided well will furnish the water.

28. Storage Tank. Furnish and erect where shown one tank of sheet steel, 7 feet diameter by 20 feet long, three-sixteenths inch thick, single riveted. Build supports for same consisting of saddles resting on two horizontal "I" beams, the north and south ends to be supported on plates in side walls. Tank to have manhole complete, and a one-half-inch tell-tale pipe running from a point six inches below top of tank to a point near well. Provide one four-inch flanged opening in top (left open) and another to receive the water supply. From latter run four-inch line to discharge of deep well; also run branches to heaters, boiler-feed pumps, house and sprinkler systems, which two latter lines will be brought into boiler room by another contractor.

29. Air Compressor. Furnish and erect where shown with necessary concrete foundations, one ———— or other approved duplex double-acting crank and flywheel air compressor, dimensions not less than 8x8x8-inch with high-speed governor. Compressor to have extra finish throughout and steam cylinders neatly lagged. Furnish and erect where shown one vertical wrought-steel receiver 36 inches diameter by 60 inches high, with one and one-quarter-inch relief valve. Provide two flanged openings in same of proper size. Also pressure gauge and drain cocks. Entire system to be designed for 100 pounds air pressure, and 150 pounds steam pressure. Provide automatic regulator controlling speed so as to maintain uniform air pressure. Run suitable pipe line from compressor to receiver, also line of proper size to deep well; the whole plant to be ample for the easy pumping of at least 180 gallons of water from the well per minute. Provide three-quarter-inch cold-water lines for jackets of air cylinders, discharging into heaters. Other contractors will run remaining air-delivery lines.

30. Pump Connections. All steam pumps will have steam connections from auxiliary steam header, and exhaust connections to main exhaust. Each pump to have suitable throttle valve, opening for cylinder lubricator and gate or angle valve in exhaust. Feed-pump suction to be so arranged that the pumps may take their supply from heaters, heating return lines, storage tank, or from city mains direct. Line from feed-water heaters to have a thermometer in same. Discharge of feed pumps to be connected to boiler-feed lines, house water supply, and sprinkling system. Boiler-feed line to have branches to each boiler, with stop valves controlled from floor level. Another contractor will bring city water line to a point within twenty feet of pumps. This contractor will make discharge connection from deep well to storage tank. Other contractor will furnish and erect sprinkling, brine, and oil pumps, and make all water and other connections to and from same.

31. Stop Valve. Provide each of the eight-inch and three-inch boiler branches with a combination stop and isolating valve of the ———— or equivalent make. To be straight-way, the eight-inch to be designed for erection with valve stems horizontal, and the three-inch vertical.

32. Pressure Reducing Valves. Run four-inch branch from main steam header through 4 x 8-inch reducing valve to heating system. Place a valve on each side of reducing valve, and provide 4-inch by-pass around same. Reducing valve to be of the ————, or other approved make, capable of being adjusted for any pressure from a slight vacuum to 10 pounds on the low-pressure side, with steam at 125 to 160 pounds on the high-pressure side. Provide similar one-and-one-quarter-inch valve for kitchen line, with three-quarter-inch by-pass.

33. Back-pressure Valve. Locate on free exhaust line in attic one sixteen-inch horizontal ———— or equivalent double-seated back-pressure or relief valve with weight complete and guaranteed noiseless in operation. This valve is to be adjustable up to ten pounds and when thrown wide open must offer no resistance to free exit of exhaust.

34. Exhaust Head. On end of free exhaust not less than five feet above roof of pent house place a sixteen-inch————, or other approved exhaust head with two-inch drain to heaters, discharging through return from heating coils. Head to be properly supported and anchored.

35. Lubricator System. Provide a complete cylinder-lubricating system of the ————, or other approved type, with condenser and sixty-gallon reservoir, with water column, located where shown. Provide all necessary pipework and sight feeds for each engine cylinder, air compressor, boiler feed and all other pumps. Where possible the supply lines are to be carried alongside of main steam pipes, inside of covering. Finished parts of system to be nickel-plated. Reservoir to be neatly painted. Top to have one-inch connection to vacuum line of dust-cleaning system for filling and one-inch line from bottom for drain to blow-off tank, with branches having coupling, three L's and three-pieces of pipe of suitable length for connection to oil barrel.

36. Gauge Board. Another contractor will furnish and install at west end of switchboard, a marble panel, 2 inches thick, with beveled edges, and to be 30 inches wide and 90 inches high, extending to floor. The Contractor will furnish and mount on same the following:

One eight-day marine clock with ———— or ———— movement.

One high pressure steam gauge reading by single pounds to 200, connected to main header.

One ——— or equivalent steam pressure recording gauge complete, connected to main header, and provided with 100 extra charts.

One low-pressure compound gauge, reading from 30 inches vacuum to 15 pounds pressure, connected to heating system.

One combination water pressure gauge, reading to 100 pounds and giving corresponding heights in feet, connected to city water mains.

One similar gauge reading to 200 pounds, connected to underground main of sprinkler system.

One air gauge reading to 100 pounds, connected to compressed air system.

One vacuum gauge for dust-cleaning system.

One vacuum gauge for system of heating.

Two exhausters for system of heating.

Leave space on board for two ammonia gauges to be furnished and erected by another contractor.

All gauges to be of———— or ————, or other approved spring pattern, eight-inch dial, nickel-plated, all carefully calibrated and properly lettered. Each gauge to have pet cock and syphon, and be connected up, ready for service. A drawing showing arrangement of gauges, etc., is to be submitted to the Architect for approval.

37. Blow-off Tank. Provide and install under boiler-room floor where shown, a blow-off tank having a capacity not less than 2,800 gallons. This tank to be provided with a suitable manhole, with cover, gasket, bolts and anchors. Run five-inch pipe from top of tank to a point at least fifteen feet above roof. Provide necessary inlet openings and connections for all blow-offs, drips and drains. Overflow to be six inches in diameter and provided with gate valve, from which another contractor will make connections to sewer through pump. Tank to be tested to a pressure of 35 pounds in the presence of the Architect. Another contractor will build inclosing chamber of brick and concrete beneath floor, with suitable cover.

38. Blow-offs and Drains. Provide suitable drain connections from cylinder and other drip cocks on four main engines, air compressor and all pumps. These are to be brought together and carried to blow-off tank. Overflow and drains from heaters and grease extractors are to be run to blow-off tank through two and one-half-inch pipe. Blow-off of each boiler is to be connected to three-inch blow-off header running to blow-off tank. All high-pressure drips to go to heater as specified above.

(To be continued.)

A Yukon Central Station.

The power station of the Northern Light, Power & Coal Company, near Dawson, Yukon Territory, is said to be situated farther to the north than any other steam-driven turbo-alternator plant in the world. The plant was installed for the purpose of supplying electrical energy to the various gold-mining companies in the Klondike region. The company has its own coal mines which furnish a semibituminous lignite.

The generating equipment consists of three 2,000-kilowatt, two 1,000-kilowatt and two 500-kilowatt turbogenerators, two 80-kilowatt exciters, and one 200-kilowatt motor-generator for supplying direct-current to the coal mine. The main supply is at 6,000 volts, three-phase, sixty cycles. The voltage is stepped up to 33,000 volts for transmission to Dawson, forty-four miles distant, aluminum conductors being used for the transmission line.

Although the temperature variation is from seventy degrees Fahrenheit below zero to 100 degrees Fahrenheit above, only one minor breakage has occurred, due to a defective joint, which was repaired in an hour. No difficulty has been experienced in operating the plant at a temperature as low as fifty degrees below zero.

The material was all shipped from Vancouver in April, 1910, transferred to railway at Skagway, and finally loaded on barges for ascending the Yukon River. The installation proceeded rapidly, so that steam was applied to the turbines by August 20, and commercial operation begun on September 2.

Electric Production of Graphite.

The extent to which graphite is now electrically produced is indicated by the fact that at Niagara Falls alone there was manufactured electrically an aggregate of 13,149,100 pounds of graphite last year.

ELECTRIC LIGHTING and ILLUMINATING ENGINEERING

ELECTRICAL ILLUMINATIONS AT KING GEORGE'S CORONATION.

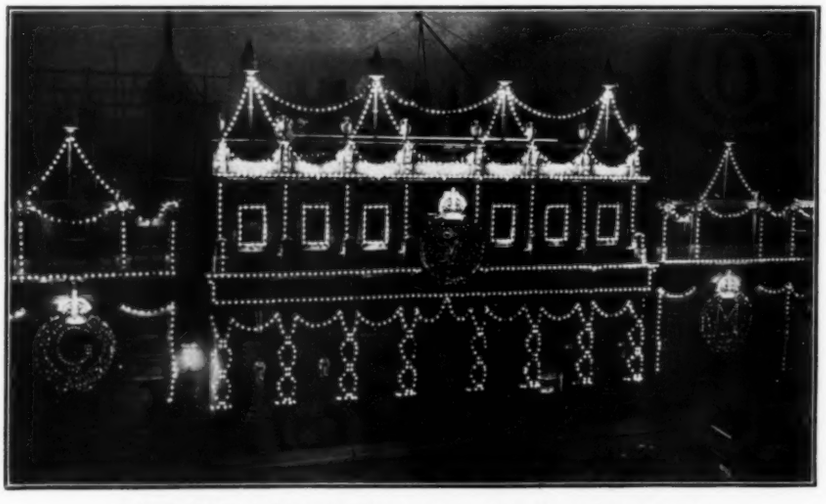
BY OUR BRITISH CORRESPONDENT.

Never before in England has electricity had so excellent an opportunity as was afforded by the illuminations in connection with the Coronation celebrations of June, 1911. And writing now after London has been a city of beauty and of light for several nights, it may be said that the result has been beyond even electrical men's expectations, while from the universal chorus of praise it is clear that electricity has made the finest impression that could be desired upon the mind of the press and of the public.

From one end of the Kingdom to the other, wherever there was a supply of electricity available this was adopted by public authorities and private persons to display the general sentinent of loyalty and the spirit of rejoicing. Municipal electricity departments combined both loyalty and commercial enterprise in outlining their works and offices for illuminating from their own supply; town halls were bedecked by the assistance of public electrical departments; electricity supply companies lavished their own supply in outside illumination of their premises and in certain cases had the work so far completed that the electrical display was nightly in evidence for ten days in advance of the coronation day. Municipal tramway departments alive to the occasion, ran specially decorated and illuminated cars. There were special inducements offered to the public to use electricity, some authorities even going to the extent of giving away whatever of their output was required for private illuminations on the public way. Others charged specially low rates with a small fee for connection, etc. These special inducements were not offered in England alone, but in other parts ot the British Empire as well; in Cape Town, for example, there was a free supply if it was asked for by a specified date. Later in the year certain parts of India will be the scene of electrical illuminations on a grand scale, on the occasion of the visit of the King and Queen, for the Coronation Durbar, for which such lavish preparations are in progress at the present time.

As an example, available at the time of writing, of the extent to which the special facilities have been accepted, experience at Bradford, Yorkshire, may be quoted. Here the corporation received applications from sixty-one consumers for the special coronation rates, and the number of carbon lamps used for these displays was 11,812, giving an extra load on the generating station of 404 kilowatts. The corporation in addition used 1,500 electric lamps for the illumination of the Town Hall, with twenty-four others of 2,500-candlepower at the top of the tower. Large illuminated fairy fountains were to be seen in Forster Square.

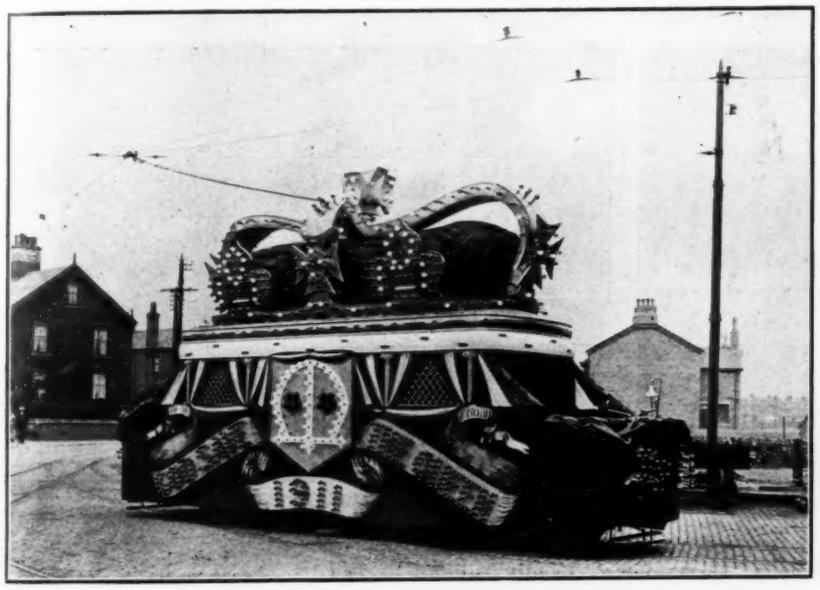
The same city may be mentioned as illustrating the efforts of electric tramway departments. Under the guidance of C. J. Spencer, the manager, two illuminated cars were prepared, one of which is shown in the accompanying picture. The cars were intended to symbolize a crown upon a pedestal, the crown proper being in gold bronze suitably lined. The crown band was perforated and behind were fixed celluloids and lamps representing jewels; on one side of the car was a ribbon with a ground work of royal blue and the words "Long Live the King, 1911" in bright gold, picked out with gold-colored lamps, also a shield in gold bearing the monogram "G. R. I." in white. red, and blue lamps respectively. A ribbon on the opposite side of the car carried the words "God Save the Queen, 1911", and a gold shield with the monogram "M" in white. The whole of the devices on the car were picked out with suitably colored lamps, there being in all 1,050 lamps used in the illumination of each car. The total height to the Maltese cross was sixteen feet, the effect when the car was lighted being extremely brilliant.



ELECTRICAL ILLUMINATION OF THE BANK OF ENGLAND.

At the renowned brewery and offices of Messrs. Bass & Company at Burton-upon-Trent there was one of the finest electrical displays in the provinces, if not in the whole country. The whole range of buildings was outlined with electric lamps; altogether 4,000 lamps were employed, of which 1,000 were used in a splendid arch across the entrance. This fine piece of work and indeed the entire scheme and the effect obtained both by day and by night can be seen from the accompanying pictures.

W. B. Ollis, Messrs. Bass's engineer, was responsible for the designing and carrying out of the work. On each of the end gables of the general offices there was an eight-point star, each having 270 lamps; the center gable bore a large illuminated shield. The windows were outlined with festoons of laurel and floral sprays, these festoons being caught up by coats of arms, lions' heads and flambeaux, all being illuminated. The arch which was undoubtedly an excellent example of what may be done when the work of illuminating is entered into whole-heartedly with artistic taste and without financial stint, was modelled in high relief. The central span embodied the national emblems of rose, shamrock and thistle, surmounted by the letters "G. V. R." and the imperial crown, while in the center was a large hand-painted illuminated portrait of the King and Queen in a crystal frame. The side arches were surmounted by the royal arms and the whole of the arch was studded with electric lamps. The supply of electricity was obtained from the municipal mains, three special transformers having been put in by the electrical department feeding over main switchboards with switches and fuses controlling the different devices.



ILLUMINATED CAR AT BRADFORD, ENGLAND.

But whatever has been going on elsewhere it is to London, of course, where so much of the wealth of the Empire is represented, and where distinguished visitors have lately thronged from all parts of the world, that one turns for electrical illuminations on a really great scale. Everybody electrical is proud of the display here. On every hand electrical strip was present; myriad carbon lamps, in red, white, blue and gold and other hues outlined buildings, entwined about their pillars, festooned between, above and beneath their windows, lit up flagstaffs, and hung with evergreen and floral rope and wreathing along roadways, over cross-river bridges, and in arches.

The costliest scheme of all was that of the Bank of England. Statements as to the actual outlay range from ten to twenty-five thousand dollars—it may be that the larger figure includes the cost of stand erection and bunting and other non-electrical parts of what was beyond question the most mangnificent undertaking of all. The design included some 5,000 carbon lamps of eight-candlepower. The Bank has its own generating plant, but for the present purpose the City of London Electric Lighting Company put in three special supply mains to feed the four main circuits which were connected two on each side of the three-wire system. There were eighty-six sub-circuits controlled from double-pole water-tight distribution boards, with an average of about fifty lamps each. Among the special devices were three twenty-foot golden wreaths embodying the rose, shamrock and thistle, the national emblems, each wreath being surmounted by a crown. There were sixteen eight-point stars arranged in four groups along the top coping, whilst two large oval medallions encircling the King's cipher were mounted on scrollwork at the ends of the front façade, with the crown above. Festoons of lamps were strung from ten electric flambeaux fixed on the top of the Bank building. The whole of the Corinthian pillars were entwined with lights, the only color here being white-tipped lamps with ruby centers. This arrangement was followed for the main outlining except in the case of the center windows and cornice above the portico, where the lamps had white hearts and ruby tips. Amber lamps for the devices and white petal floral reflectors for all lamps on the strip, produced a very effective result.

Facing the Royal Exchange one has on the left hand the long stretch of the Bank of England just referred to. The Royal Exchange itself was electrically lighted with 3,500 lamps so far as the entwining of its pillars with strip was concerned and the dropping of festoons across from pillar to pillar at a considerable height, but its top lights and large central device used gas. To the immediate right of the Exchange are the premises of the London, Liverpool & Globe Insurance Company—a building more lofty than others surrounding it, and with a dome, which always gives the electrical man a good chance. The design included innumerable frosted electric lamps outlining the windows, columns, and dome, and a number of crowns, roses, thistles, and shamrocks in electric lamps. Again on the right, leading off between the Exchange and the Mansion House, is Lombard Street, the abode of many banking interests. Here the bankers had co-operated in a scheme which cost about $5,000. Across the roadway were six arches while along both sides were evergreen and floral festoonings with white and gold electric lamps set therein. Many special signs, each having its own special significance and reminding one of days gone by, were hung at different points. One of these which shone out more brightly than the rest was an anchor in frame, some 200 frosted electric bulbs being used therefor.

Emerging at the other end of Lombard Street, one had not many yards to walk before reaching London Bridge which afforded another excellent example of electrical and floral festoonings and archways. Between 3,000 and 4,000 electric lights in white and gold, and studded among the frame-work of the ornamental arches, were used here.

Retracing our steps to the Bank, the Mansion House and a number of other

buildings in the same charmed quarter, created a deep impression. For all of the buildings in this vicinity it might have been imagined that there was a concerted effort to secure a harmonious scheme of almost purely electrical magnificence. Standing near the Wellington Statue in front of the Exchange one could get a daylight night effect of electrical grace and beauty such as London has never seen before.

The Mansion House had its pillars wreathed, and its main lines and windows covered with some thousands of colored electric lamps, but gas flambeaux were on the roof and large gas devices were fitted into the general scheme. With a profusion of foliage, artificial flowers, and bunting, the effect produced at night by the colored lights was admirable.

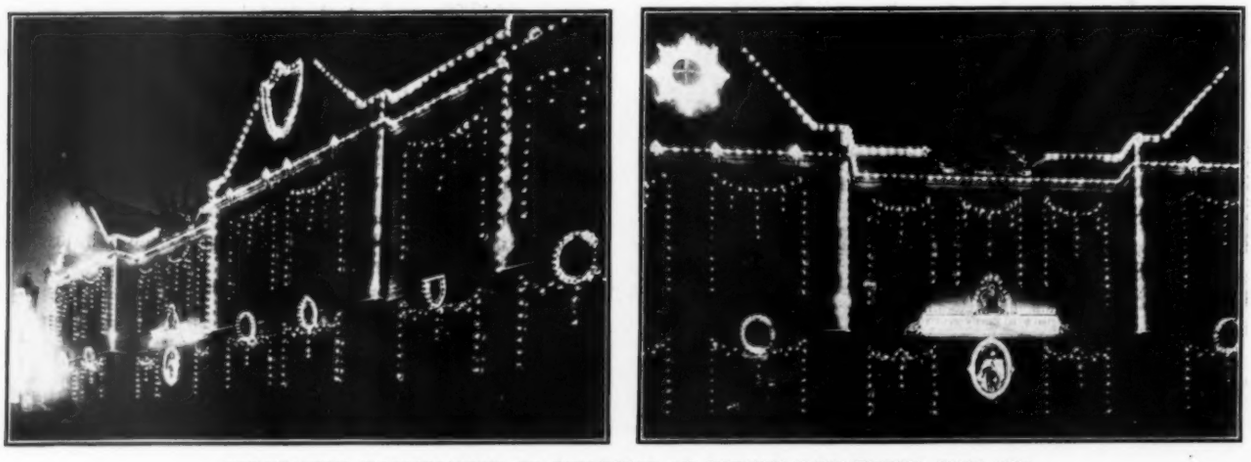
Passing through the city in search of matters of interest electrically one naturally stopped at the "Mazda" building of the General Electric and British Thomson-Houston Companies in Cannon Street. Electric strip clung down the sides of the building and stretched from the center of the top downwards to a point at either side. A crown illuminated with fifty or sixty lights and the letters G and R were all set within a large circle composed of Mazda lamps. At each of the four corners of the design were small electric stars.

At Temple Bar where their majesties made one of their principal halts, being there received by the Lord Mayor and Corporation representatives, one of the many triumphal arches forming part of the London schemes was erected, and here the lattice work of the arch was studded with electric bulbs. It will add interest here to mention that real flowers were used in the decoration of this arch, and they were renewed daily for more than a week. Very beautiful effects were also obtained at a number of private displays by the use of real flowers and evergreens lighted up by electricity. In one of the West End schemes orange trees, upon the branches of which hung electric fruit, formed a noteworthy and pleasing novelty. Electric flowers—lamps concealed within colored floral shades—formed a conspicuous part of many efforts, and flower baskets with electric lights were also used.

The Gaiety Theater had its dome and balconies outlined electrically, and at Selfridge's great emporium in Oxford Street a gorgeous scheme included an enormous crown placed above the towers. This crown was illuminated by 400 electric lights and its measurements were about nine feet in circumference and eight feet in height.

Along Piccadilly among the general schemes of color and decoration festoons of yellow bulb electric lights hung both across and along the thoroughfare. The Piccadilly Hotel was covered with about 3,500 feet of strip carrying 4,200 electric lamps, in red, white, and blue, the main pillars being alternately outlined in these colors. A number of five-foot flambeaux, two large illuminated crowns, and other details made a load of 168 kilowatts. The Royal Colonial Institute had some special devices of "union jacks" encompassed by the "garter" surmounted by a crown, the design being worked out in electric bulbs of suitable colors on a colored base. At the American Embassy in Park Lane there was a huge shield colored in royal blue surmounted by a heavy edging of gold with a monogram "M G" fixed in the center all in gold. Above the shield were five flags American and English entwined, beautifully outlined in colored electric lamps. This device measured twenty feet high and weighed one-half ton. Among the other devices at the American Embassy was the American Eagle embossed in gold and lighted up from seventy concealed lamps. Altogether the Embassy scheme included between 4,000 and 5,000 lights.

The White Star Line Building in Cockspur Street had close upon 3,000 electric lamps, some of these being used in a large star, and others in a model in electricity of the *Olympic*. Among the scores of other things of an interesting character that might be selected for reference are the features adopted by numerous banks, insurance companies, hotels, theaters and clubs, but we must be content with the foregoing general indication of the extent and nature of the effort that has been made.



CORONATION ILLUMINATION OF BUILDINGS AT BURTON-UPON-TRENT, ENGLAND.

There ought, however, in conclusion to be mentioned a large electric sign displayed at the British and Foreign Bible Society's premises, brilliantly shining out the words "The Bible: the First of National Treasures" words used on a recent occasion by King George himself.

One writer in the press has aptly described the scene generally in London, and at 8:30 o'clock on the night of June 22, when building after building switched on its electrical display, as "a midsummer night's dream of rare and wonderful beauty." Another writer, again in a leading London daily, tells his readers that from the spectacular point of view "electricity won handsomely," not only in illuminations on land, but in connection with the brilliant effect at Spithead on the night of June 24, the day of the King's review

of the fleet. "On the whole the technical men concerned have every reason to be satisfied with the way in which the illumination of London was carried out, and with the manner in which everyone appreciated their efforts. It was a splendid advertisement."

The whole of the temporary electrical illumination work in the metropolitan area, in which between 2,500,000 and 3,000,000 incandescent lamps were utilized, had to comply with special regulations prepared by the Fire Brigade Committee of the London County Council. These regulations are as follows, with the exception of No. 1, which is one specially issued by the City Corporation concerning schemes carried out in its area. It may be of interest to print these regulations in view of the excellence of the display, and the freedom from failure, accident, and fire.

(1).—Temporary illuminated signs and devices must not project more than 4 feet 6 inches from the front of the building to the extreme edge of the device, or be at a less distance than 2 feet from the carriageway. The height of such projections must be of a minimum of 8 feet from the pavement to the underside of the device.

(2).—All circuits and subcircuits should be provided with double-pole fuses of a suitable capacity. Subcircuits should not carry a current exceeding ten amperes, and all circuits should be arranged with proper regard to the current density in the conductors.

(3).—No bare conductors should be used in any place, and all conductors within reach of the public should be specially protected by suitable conduits, and all metal conduits or covering be efficiently earthed.

(4).—All switches, fuses, terminals and connectors should be protected from the effects of weather and from the possibility of mechanical injury.

(5).—All installations should be inspected, tested and approved by the local supply authority before connection is made, and any installation that has not a satisfactory insulation between poles, and between either pole and earth, should not be connected.

(6).—Festoons, garlands, etc., containing lamps should be provided with means of support and independent of and insulated from the conductors, and should be secured in such a manner as to minimize risk of injury from wind.

(7).—All shades and decorations of combustible material in proximity to lamps should be rendered non-inflammable by a process which will withstand the action of rain for several days, and no shades or decorations of celluloid or similar substance should be employed.

(8).—The installations should, when practicable, be connected at the main intake or at the main distribution boards so as to avoid the possible overloading of the house wiring.

Notes on Illumination.

A paper on this subject was read before the Junior Institution of Engineers, London, on May 10, 1911, by F. J. Hawkins. The author dealt in a general manner with the chief recent advances in gas and electric lighting, and briefly reviewed a few special problems, such as the lighting of streets, shops, private houses, etc.

Mr. Hawkins laid special stress on the importance now attached to avoiding glare and to the value of shades and reflectors as a means of screening illuminants and directing their light where needed. In this connection he referred to the interesting work of A. J. Sweet, who had analyzed the requirements of street lighting, and shown how absence of glare was compatible with uniform illumination. To achieve this result he designed a special combination of Holophane reflector and opal outer globe. The principle that every source of light is incomplete without an appropriate shade or reflector is now being generally appreciated; Mr. Hawkins mentioned the Excello dioptric globe, and the Peard reflector used with the Oriflamme arc lamp, as illustrations of this tendency.

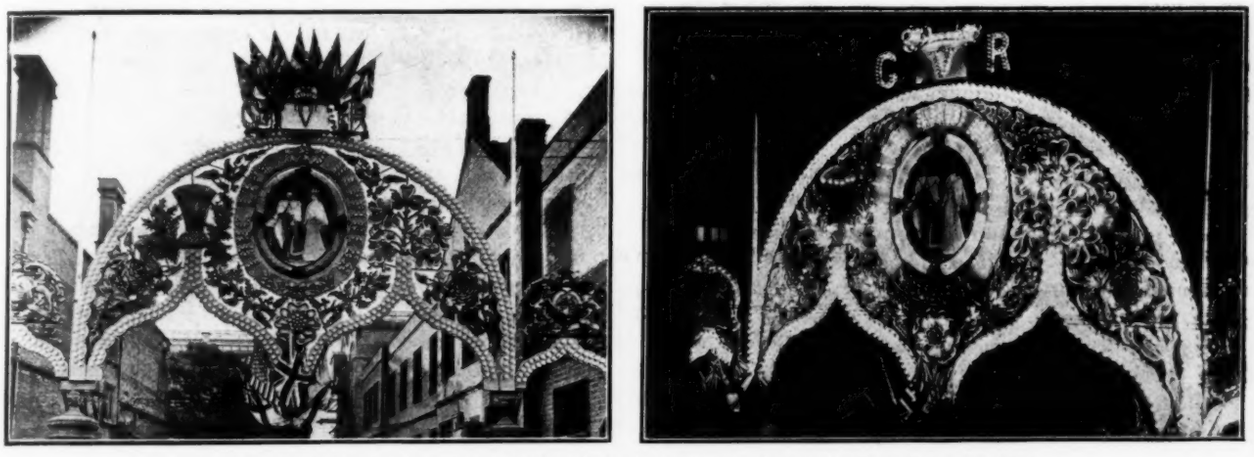
In dealing with shop lighting, Mr. Hawkins laid stress on the desirability of illuminating the goods by concealed lamps, and contended that outdoor brilliant lights were unnecessary. Turning to domestic lighting he pointed out that consumers are often reluctant to alter the positions of lamps and disturb existing arrangements. Consequently it is often only by effective shading and direction of light or by introducing new types of lamps, that substantial improvements can be made. Mr. Hawkins also referred to the effect of wall papers on interior lighting, and gave a table of reflective powers of different materials.

The discussion which ensued was opened by P. J. Waldram, who referred to recent advances in illuminating engineering. Haydn T. Harrison made a few remarks on the nomenclature adopted by the author, and referred to the need for better illumination in side streets. K. Edgcumbe gave some additional illustrations of the deleterious effects of glare.

W. J. Liberty said that the height recommended for street lamps, thirty feet, was more than would often be necessary. He also commented on the value of centrally placed sources at points where four roads converged.

J. S. Dow agreed that the illumination of the goods in the window in shop lighting was the chief essential; he thought that Mr. Hawkins had rather overlooked the advertising value of outside lamps, although they should be properly arranged to avoid glare.

T. E. Ritchie dealt mainly with arc lamps and the advantages of indirect lighting; he thought that up-to-date firms were now alive to the importance of distribution of light from sources as well as intensity.—*Illuminating Engineer*, London.



DAY AND NIGHT VIEWS OF CORONATION ARCH, BURTON-UPON-TRENT, ENGLAND.

TELEPHONY—TELEGRAPHY, *and* WIRELESS.

LINE-CONDUCTOR REQUIREMENTS FOR TELEGRAPH TRANSMISSION.[1]—I.

BY FRANK F. FOWLE.

INTRODUCTION.

Telegraph transmission from an engineering standpoint seems to have attracted comparatively few investigators, and when the author undertook a complete investigation of the subject more than a year ago it was found that the existing literature was extremely meager. On the side of practice the telegraph companies have adhered quite closely to rather ancient standards, although there have been persistent efforts to bring about improvements in equipment and radical changes in transmission methods. Very lately there have been a number of notable improvements in equipment, but practically all of the telegraph business of the country is still handled by the Morse system, with manual operation.

Dealing from an engineering standpoint with transmission problems as they now arise, the Morse system becomes practically the sole consideration. The problem of greatest fundamental importance is how to secure commercially efficient transmission at the lowest cost; and where long distances are involved, the largest single factor is the selection of the line conductor. But over-all or total efficiency has here two components, or factors—the efficiency of the line and the efficiency of the equipment. Naturally each affects the other, and a proper solution in any case implies that the chosen combination of line and equipment is the most economical one.

It is very well understood in the case of telephone transmission that the size of the line conductor must be increased as the length of the line increases, which was illustrated in a paper read before this association, by the author, in 1905. The same is true in the case of telegraph transmission, although no rule could be found which expressed the size or properties of the conductor in terms of the length of the line. Perhaps an exception ought to be made in the case of lines wholly in cable, for there the well known *KR* law has been employed empirically to find the required properties of the conductor. But certainly in the case of lines made up in great part, or wholly, of open wire, there has been no well established rule or procedure, except to copy existing practice.

Long experience with Morse transmission, by the various telegraph companies, has gradually evolved the present standard practices, reached in most cases by cut-and-try methods. Today there are two types of line conductors used very extensively, No. 9 Brown & Sharpe gauge hard-drawn copper, weighing 209 pounds per mile, and No. 8 Birmingham gauge B. B. galvanized iron, weighing about 385 pounds per mile. These conductors are standard, the former for the lines of greatest length and severest service, the latter for the lines of short and medium length and quite generally for way or local wires. It has become rather the custom to accept these standards without much question as to how closely they fit the needs of the case, or whether different conductors could not be substituted with a marked saving in cost.

Standards are intended in general to promote economy, through the benefits of uniformity and flexibility. They are clearly desirable in every business of considerable magnitude, yet it ought to be recognized that a stubborn adherence to standards merely for their own sake is a serious impediment to progress. There is a middle course in this matter which adheres to standards merely so long as they serve a good purpose, and sacrifices something of uniformity and flexibility to secure the benefits of new inventions or developments and general progress in the art.

In the respect of wire standards the telephone companies adopted No. 12 N. B. S. G. (173 pounds) and No. 8 B. W. G. (435 pounds) copper in the early stages of development, but with the advent of phantom circuits and loading there are now at least eight standards instead of two. While so large a number might not be chosen voluntarily, there is nothing of serious consequence to fear in increasing the number from two to three, or perhaps four. This is true particularly in relation to telegraphy, where automatic repeaters can be brought into play so readily. There is then no evident reason why the introduction of new wire standards is objectionable, either to replace existing standards or to increase the number of standards, provided only that economy justifies it.

The specific problem placed before the author in the investigation before mentioned was a comparison of various kinds of wire for telegraph service, and a determination of their relative costs. Finding no established theory or procedure as a guide, it was necessary to develop the theoretical side of the subject rather elaborately. This work led to results somewhat beyond the intended scope of the investigation and pointed the way to numerous improvements in telegraph practice, which will be described in their turn.

The purely theoretical side of the work is too extensive to present to you here, and has been published elsewhere. A paper[2] by the author on "Telegraph Transmission" will be presented during the present week before the annual convention[3] of the American Institute of Electrical Engineers at Chicago, which gives a full exposition of the theory involved. A professional report by the author which deals with the same subject has appeared also; this will be found in serial form in *Telephone Engineer*, commencing with the issue of October, 1910. You are referred to these for the development in detail of

1 A paper presented before the Association of Railway Telegraph Superintendents at its thirtieth annual convention, Boston, Mass., June 27.

2 See *Proceedings* of the American Institute of Electrical Engineers, June 1911, pages 1187 to 1242.

3 See ELECTRICAL REVIEW AND WESTERN ELECTRICIAN, July 8, page 59.

the results which are presented herewith.

Morse transmission as employed so extensively in this country makes use of the familiar closed-circuit system, and operates with direct-current sources of electromotive force, or energy. In the transmission of impulses, by the opening and closing of a key, there are two distinctive intervals or time-periods to consider. The first interval is that during which the current is changing from one steady value to another, which commences at the instant of opening or closing, and is termed the transient state. The second commences when the steady current value has been established or the transient state ceases, and continues until the next movement of the key. During the transient state the current obeys very complicated laws and in general it takes the form of a high-frequency oscillation. But the transient state is of very brief duration, except in long cables. During the second or steady state the current obeys Ohm's law in every case.

In general there are two factors of practical moment in judging the commercial quality of transmission. These factors are not always separable, but for present purposes we may regard them as so. The first is the speed of transmission, as affected by the duration of the transient state; if the transient state occupies a comparatively long interval, as in high-capacity cables of great length, the signals must be sent at very low speed in order to preserve their individuality and insure their arrival at the far terminus. On lines of open wire not exceeding 500 or 600 miles in length, the transient state is exceedingly brief, and the speed of signaling is ordinarily far above the maximum ability of an expert manual operator.

The second factor is the strength of the signals. Whenever the line is very highly insulated the final strength of the received signal will equal the strength of the outgoing signal, and both are determined by Ohm's law. Referring again to the case of long cables, it is obvious that an outgoing signal may be cut so short that it will never arrive with full strength at the distant end. But open wires have entirely different properties and the very brief nature of the transient state insures that the shortest signal, with manual operation, will penetrate to the far terminal with full strength, when the insulation is high. In every case, however, it is evident that inadequate strength is a factor which positively limits transmission, no matter whether the speed is high or low.

Cable transmission, referring to underground and aerial construction, is limited, as we all know, by considerations of speed. There the insulation is ordinarily several hundred megohms per mile, and there is no perceptible loss of current by leakage at any time. Open-wire lines, on the other hand, are never very highly insulated under any conditions, and the degree of insulation fluctuates between wide extremes with changes of weather. Hence both speed and strength of signals must be considered in the latter case, and the KR law is entirely inapplicable for these and other reasons.

Experience with open-wire lines shows us, in a very conclusive way, that where the current strengths are adequate and the relays are properly adjusted, the limits of distance or line length are fixed by the maximum leakage (or minimum insulation resistance) and not by the inability to signal with requisite commercial speed. It is well known, for illustration, that signals can be transmitted to greater distances when the insulation is high, or in fair weather, than when it is low, or during a prolonged or heavy rainfall. American experience confirms this almost universally.

Proceeding from these facts, the theoretical investigation of transmission was confined to a study of the second or steady state, before mentioned, which obeys Ohm's law. The statement of this law in its elementary form is exceedingly simple, but the application of it to the case of a long line with uniformly distributed resistance and leakage requires the use of considerable mathematics, although not of a difficult order. The results of the mathematical analysis will now be considered.

RESULTS OF THEORETICAL ANALYSIS.

Under conditions of perfect insulation the current in a telegraph line of open wire is everywhere the same, after the very brief transient state. This condition is practically realized under fair-weather conditions where the insulators are clean. Opening the home key, for example, completely interrupts the current in the relay at the distant terminal. But when there is leakage in any appreciable degree, this is not the case. Assuming that there is a source of electromotive force at each terminal, the home key cannot wholly interrupt the current in the distant relay, because a certain amount of current will issue from the distant battery or generator to the line and leak to earth through the defective insulation. The difference between the currents in the relay in the two cases is the actual operative current—or margin, as it is often called. The margin will decrease as the leakage increases and finally a point will be reached, with increasing leakage, beyond which the relay will not respond, at any adjustment. The lowest operative margin clearly fixes the limit of transmission, which is true for all the common forms of simplex, duplex and quadruplex transmission.

The case of simplex transmission is the easiest to follow and the formula for finding the operative limit of distance or length of line will be explained briefly.

If I is the current at the far terminal when both keys are closed and I' is the current there when the home key is open, the margin is the difference between these currents, or

$$m = I - I' \qquad (1)$$

In order to simplify the final formula, let n be the ratio of the full current to the margin, or

$$n = I/m \qquad (2)$$

and the final formula for the maximum or operative limit of line distance is,

$$l = \left(\frac{2.303}{B}\right) log \left[\frac{n\,(1+a)}{2} + \frac{\sqrt{n^2\,(1+a)^2 - 4a}}{2}\right] \qquad (3)$$

where the several symbols stand for the following quantities:

$$B = \sqrt{rg} \qquad (4)$$

$$a = \frac{K - r'}{K + r'} \qquad (5)$$

$$K = \sqrt{\frac{r}{g}} \qquad (6)$$

$$g = \frac{1}{R} \qquad (7)$$

l = length of the line, in miles.

r = resistance of the line wire, in ohms per mile.

R = insulation resistance of one mile of line, in ohms.

r' = total resistance of each terminal, assuming them to be alike, including relays, wiring, batteries (or generator and lamp resistance) and connection to earth.

These formulas enable the calculation of specific results when the relay margin is known. A series of careful tests of a standard 150-ohm relay indicated that a margin of 10 milliamperes, with a full operating current of 50 milliamperes, was the lowest commercial value that

could be expected under expert adjustment. This would give a value of n equal to 5.00, but was considered too near the limit. A value of 4.00 was finally selected as conservative; this corresponds to a margin of 12.5 milliamperes with a full current of 50 milliamperes, or a margin of 15 with a full current of 60. In general the largest value of n, and correspondingly, the largest value of l, will be obtained with maximum operating current. That is to say, the best results will be obtained with a full line-current of 50 to 60 milliamperes, or more. Equal values of n can be obtained with 35-ohm relays where the full current is well up to 60 milliamperes, or perhaps higher.

The lowest value of insulation resistance ordinarily encountered is not the same in different localities, because it depends so greatly on the surface condition of the insulators and upon the number per mile. It depends further upon the material of the insulator to some extent, but much more upon its shape. The double-petticoat glass insulator, of familiar pattern, has been the standard in telegraph practice for many years.

A consultation of the authorities on insulation resistance of open-wire lines, taken in conjunction with the author's experience, led to the adoption of 0.25 megohm per mile, as a safe and conservative minimum. This is presented purely as an average and may be too high or too low in specific cases. In exceptionally dirty atmospheres it is much too high, of course. The insulation will ordinarily fall somewhat after the insulators are placed in service, owing to the gradual accumulation of dirt and soot. In regions like the Pittsburg district it probably pays to wash the insulators periodically.

Terminal resistances vary to a great extent, sometimes unavoidably, but often because little attention is paid to them. This matter is quite important in its relation to transmission, however, and the lowest values of resistance give the maximum limits of distance or line length. An average value of 300 ohms has been selected for the purpose of later calculations.

Intermediate offices add materially to the line resistance and cut down the limits of transmission. When such offices are distributed with fair regularity, as usually happens, it can be assumed without substantial error that the relay resistances act as though they were uniformly distributed in the line wire itself. For example, 35-ohm relays every ten miles could be assumed to add 3.5 ohms per mile to the line wire, or if spaced every five miles, to add 7.0 ohms per mile. It is a matter of some importance to keep these resistances as low as feasible and increase the operating current. The same observation applies to bridle cables, and office wiring; it is poor economy, for example, to wire an office with very small wire when the line itself is No. 9 B. & S. copper. In this respect a most economical size of wire can always be found for a given set of conditions, that is, a particular size which makes the whole cost a minimum.

A set of calculations has been carried out with the foregoing values of insulation resistance, terminal resistance and relay margin. The results are given in Table 1.

TABLE 1.

Operative Limits of Telegraph Lines Having Various Resistance Per Mile.

Line Resistance in Ohms Per Mile.	Line Limit, in Miles. Through Circuits.	Intermediate Offices. Every 10 Miles.	Every 5 Miles.
2	597	391	313
3	510	363	299
4	450	341	286
6	376	305	265
8	331	280	248
10	299	260	234
15	248	225	208
20	217	201	188
25	195	183	174
30	179	170	162
40	156	150	144
50	140	...	...

These figures are notable in a number of ways. The rapid increase in conductivity of the line wire as the length of the line increases is the feature of fundamental importance. For example, a through circuit 217 miles long requires a wire having not more than twenty ohms per mile, while a line 450 miles long requires a wire having not more than four ohms per mile; in this comparison the second distance is slightly more than double the first, but the conductivity required is five times as great. Many similar examples can be taken from the table. In general the required conductivity per mile increases a little faster than the square of the length of the line.

When the same comparison is made for way or local wires, the required increase in conductivity with increasing distances is even more marked. In the case of a way circuit with thirty-five-ohm relays every five miles, a line 144 miles long requires a wire having not more than forty ohms per mile, while a line 286 miles long requires a wire having not more than four ohms per mile, or ten times the conductivity for double the distance. In other words, the conductivity in this case increases faster than the cube of the length.

The table also shows clearly how the introduction of way offices reduces the limit of transmission. For example, a ten-ohm wire has a limit of 299 miles as a through circuit, but only 260 miles as a way circuit with offices every ten miles and 234 miles with offices every five miles.

It is particularly interesting now to change the form of formula (3) so as to show the required weight of conductor in pounds per mile. This can be done readily by the use of the mile-ohm, which is the weight of a conductor one mile long whose resistance is one ohm. If r is the resistance in ohms per mile and w is the weight in pounds per mile, the value of the mile-ohm W, in pounds, is

$$W = w\,r \qquad (8)$$

and the new formula for the required weight of wire per mile is

$$w = \frac{0.1886\,W g l^2}{\left(\log\left[\frac{n(1+a)+\sqrt{n^2+(1+a)^2-4a}}{2}\right]\right)^2} \qquad (9)$$

and for particular values of a and n this formula can be put in the simpler form,

$$w = k\,W\,g\,l^2 \qquad (10)$$

where k is a numerical constant. This formula is very convenient for discussing the cost of a line under stated conditions, because bare line wire is always sold by the pound.

It shows first that the required weight is directly proportional to the leakage conductance, or inversely proportional to the insulation resistance. That is to say, if the insulation resistance can be doubled, by the use, for example, of better insulators, the weight and the cost will be halved; and if the insulation resistance can be quadrupled, the cost will be quartered. This is one of the most significant conclusions from the whole investigation.

The formula shows next that the weight and the cost per mile increase as the square of the length of the line. Therefore, the weight and the cost of an entire line increase as the cube of the length. As a matter of fact, if the same terminal conditions are assumed in each case, the whole cost increases a little faster than the cube of the length. This result has a most important bearing on the use of automatic repeaters. A repeater station represents some additional investment and requires special attendance, both of which increase the annual costs. The problem here, in a

practical engineering sense, is to balance line costs against repeater costs for the purpose of determining how long a line can be economically worked without repeaters. There is not sufficient space in a brief paper to discuss this particular problem exhaustively, but sufficient data is before you to commence a study of it. If the cost of a complete line without repeaters increases as the cube of the length, that is, eight times the cost for double length, for example—then it is evident that at some point of increasing length it will cost no more to use a repeater station at the center of the line, and thus make the line wire much lighter, than it would cost to use the heavy wire without repeaters.

It frequently happens that a Morse circuit is derived from a metalic telephone circuit by means of the familiar composite and simplex systems. Each of these systems sacrifices the Morse efficiency to some extent in order to secure simultaneous use of the line. The foregoing theory applies, with limitations, to the standard composite system; but on account of the greatly increased retardation, artifficially added, the leakage theory must be applied with great caution. That is to say, where the theory is applied to find how greatly the limit of working distance can be extended by means of better insulation, there are new limitations from a telephonic standpoint. Or in other words, it is no longer safe to assume that the transient state during the transmission of an impulse is of negligible duration. But in general the conductor requirements from the standpoint of telephonic transmission will govern, and satisfactory Morse service will follow as a consequence. This is not equivalent to saying, however, that improved insulation will be here devoid of beneficial results.

The simplex system is in theory a pure phantom circuit and mutual interferences are not present. The application of the leakage theory of telegraph transmission needs slight modification, because the two line conductors are telegraphically in parallel. That is, the simplex line has one-half the resistance and double the leakage of either component wire. Hence the new value of B is

$$B = \sqrt{\frac{r}{2}(2g)} = \sqrt{rg} \qquad (11)$$

which is the same as before. But the value of K is now

$$K = \frac{\sqrt{\left(\frac{r}{2}\right)}}{2g} = \frac{1}{2}\sqrt{\frac{r}{g}} \qquad (12)$$

which is one-half of its previous value. Assuming that the terminals are the same, this reduces the value of a and slightly impairs the operative limit of distance or line length. In other words, a simplex circuit is somewhat less efficient than either component wire used as a straight circuit, for two reasons: first, the resistance of the terminal impairs the working margin to a greater extent; and second, the added terminal resistance caused by the simplex coils accentuates the first effect.

In general, the terminal resistances should be as low as possible, and the ideal resistance theoretically is zero. This cannot be obtained, of course, but it should be approached as much as possible.

(To be continued.)

Telegraph Extension in China.

The Chinese telegraph administration, in view of the close working arrangements with the eastern extension, Australasia & China Telegraph Company, British, and the Great Northern Telegraph Company, Danish, has concluded an agreement with the two last named companies whereby it is to receive an advance of $2,433,250 on the foreign traffic dues of the next eighteen years; that is, the two companies are to have as security a lien on the balances payable by them on the Chinese telegraphs under the joint-purse agreement of July 11, 1896. This agreement and, in fact, all other existing agreements and concessions between the administration and the companies were extended to December 31, 1930.

It is stipulated that the money is to be utilized only for the development of telegraphs and telephones, and that the telegraphic charges on the land lines in China should be restricted to ten cents Mexican (4.3 cents American currency) per word for all points within a province, and fourteen cents (six cents American) per word between all points within any two adjoining provinces.

Any improvement and extension in telegraphic communications and in installing systems of telephones, as those contemplated by this loan, should create a demand and thus offer a promising market for appliances of all varieties along the above mentioned lines. It is hoped that American manufacturers and exporters interested in these classes of products will give this matter their prompt and earnest attention. It is suggested that they might find it advantageous to address directly W. P. Chow, Director General Imperial Chinese Telegraphs, Shanghai, or His Excellency Sheng Kung-pao, President of the Board of Posts and Communications, Peking.

The Telegraph and Telephone in England.

London claims the largest telegraph office in the world. There are underground telegraph cables from the extreme north of Scotland to the southernmost point of England, a distance of fully four hundred miles, with similar underground trunks east and west.

The Post Office has now nearly 1,200,000 miles of wire, half for telephone, and nearly 750,000 miles of that aggregate is underground or submarine cables, proof against snow, sleet and wind.

One class of telephone business developed in London is that of the private line between two business houses or a man's office and his home, over which he can speak without going through an exchange, merely lifting his receiver to make a call. The service is fairly cheap, as it carries no operating expenses, and is further attractive because no royalties need be paid to the postoffice on this kind of connection. Both the national and the post office have many such lines.

The American in London usually finds marked differences in telephone terms. Instead of "busy" people say "engaged." "Hello" is now common, but many still stick to the polite English inquiry in answering the telephone, "Are you there?"

The toll lines are called "trunks." Even the public asks for "trunks" instead of "long distance." Lines between two exchanges are "junction wires." Instead of saying, "Please hold the line" people ask "Will you please hold on."

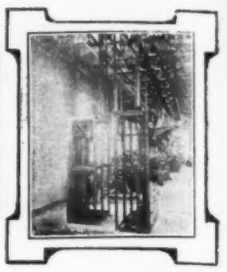
Submarine Telephone Cable.

A fifty-mile gutta-percha cable containing Pupin coils has been ordered for use between England and Belgium in telephone service.

Wireless Station for Madrid.

The Spanish Government is about to erect a wireless station in the camp at Carabanchel, near Madrid, the range of which is 300 miles beyond the coast.

Industrial Power



Central-Station Service For Wood-Working Plants.

The intermittent character of the average machine load in wood-working plants results in a heavy continuous charge for general maintenance of hundreds of feet of overhead line shafting, which actual tests show to be non-productive from 35 per cent to 90 per cent of the running time.

With the electric motor equipment, and central-station service, power is consumed only while the machine is running and in proportion to the work it is doing and when production stops power costs stop.

Electric drive minimizes the danger of accidents and delays and makes it possible to operate a single machine without regard to any other.

One of the most important questions that arises when considering the use of central-station service is the wood refuse. In the average plant of this nature a certain amount of steam is required at a lower pressure, either for dry kilns, steaming, bending, etc., which in most cases will consume all of the refuse, and in considering an electric equipment the cost of same should be compared with cost of coal and attendant expenses, to generate and deliver power with steam engine and a long line of shafting and beltings.

In a recent issue of the *Manufacturers' Record*, G. U. Borde calls attention to the process for obtaining valuable products from wood refuse, which, when properly treated, every ton of theoretically dry wood, or 3,200 pounds of green saw dust will give:

30 gallons of 188° alcohol at 40 cents	$12.00
76 pounds acetic acid at 6c	4.56
0.75 ton stock food at $23.00	17.25
Total	$33.81
Cost of production	$ 7.00
Net value of products per ton dry wood	$26.81
Net value of products per ton of green saw dust	$16.80

One and a quarter long tons, which is the approximate weight of 1,000 feet of lumber, has, when transformed into above products, a value of $33.51. Assuming that it requires two tons of wood to equal one ton of coal in heating value, and that the net returns from this process are but $10.00 per ton, it is evident that saw dust is not the inexpensive fuel which it has always been considered. This process is already in extensive commercial use both here and abroad.

A Motor-Operated Baling Press.

Electricity is now being adapted for working baling presses. Hitherto hydraulics have practically held the field against all comers as the source of power for such presses. In places where the water pressure cannot be obtained from a central source, the use of hydraulic pressure carries with it the necessity of installing pumps, intensifiers or accumulators with their attendant heavy foundations and exeavations. Now electricity is being introduced for this class of apparatus and a new type of baling press operated by an electric motor has been designed and constructed. In this press the moving table is swung from the press head by means of steel-wire ropes, which are arranged in sets of four, two at each end of the table, which is equivalent to lifting at the four corners. The end of each rope is secured to the press head and passes round a number of sheaves, whereby a purchase is obtained; the free ends of the four ropes being wound simultaneously onto drums, which are directly driven from a reversible motor, through suitable reducing gear. As is well known, in the hydraulic system the press head is attached to the cylinder by corner tie rods of the requisite combined sectional area to withstand the full pressure exerted by the ram. In the electric press no such stresses are involved on the corner pillars, which merely support the press head and the machinery contained thereon; consequently they only act as guides for the moving table on which the bale, or the material to be compressed is placed. This table is forcibly pulled up by means of the steel ropes, which divide the load equally. Both this table and the press head are therefore of similar design and are simply beams or girders supported at the ends and loaded in some symmetrical manner, distributed about the center line.

A series-wound motor is adapted in which the ratio of speed from no load to full load is at least three to one; this ratio can if necessary be made greater by employing a diverter resistance in parallel with the fields, or by using a double-commutator motor with a series-parallel control. The motor is run in one direction to lift and in the reverse direction to lower the table an important feature of the new electric press being that the sheaves should be limited to such a number, that the efficiency of the wire-rope blocks may be more than fifty per cent when lifting the empty table, under which circumstances the table will run down by its own weight when the motor is reversed and the ropes are paid off the drums.

As the material or bale is compressed the motor current gradually increases to a maximum corresponding to the total pressure required. Duplicate circuit-breakers operate to open the circuit at the point of maximum load and an automatic brake on the armature spindle sustains the table without further expenditure of electrical energy.

The size of the motor required is determined by the maximum specified pressure and the final speed of the table at that point; thus in a 100-ton press having a final speed of three inches per minute, the work performed would be at the rate of 50,000 foot pounds per minute, or say 1.5 horsepower; the brake horsepower of the motor being about fifty per cent greater than this figure to allow for losses due to friction, as is usual in the design of electric cranes. The motor may, however, be more highly rated than for steady load, for not only does it run for a very short period, but the average of the load

curve is only twenty-five per cent of its maximum. Very little resistance is offered during the greater portion of the compression, which simply means expelling air from the folds of the material to be compressed.

Testing Electric Mine Motors.

The testing of electric motors to be used in gaseous mines necessarily demands great care. According to the *Engineer*, at a works in Germany a testing chamber is employed built of strong wooden beams reinforced by iron bars. The front of this structure is closed by elastic paper walls, while all the other sides are solid, making an almost air-tight chamber. Into this the motor to be tested is placed and started. Then gases of various mixtures, corresponding in composition to every conceivable mine gas, are led into this chamber. The gases entering the motor itself are ignited by electric spark from the outside. If the protective plates and case are perfect, the explosion does not spread to the outside of the motor and communicate with the gases in the experimental chamber.

The tests are repeated about twenty to thirty times with various gas mixtures, and only if no explosion results are the motors put into actual use. In case of an explosion, the paper walls in front of the chamber act as safety valves.

All switches, apparatus to test gases, etc., are on the outside of the chamber in a small observation house a short distance away.

Railless Trolley Vehicles at Bradford and Leeds.

On Tuesday, June 20, with the usual ceremony, the railless trolley vehicles at Leeds and Bradford, England, began running. The vehicles have been supplied by the Railless Electric Traction Company, of London, to the joint specification of the corporation tramway managers of Leeds and Bradford, J. B. Hamilton and C. J. Spencer. The cars have seating accommodations for twenty-eight passengers. They have two motors, each of twenty horsepower. These are Siemens interpole traction motors with shunted fields. The wheel base is thirteen feet; width of rear wheel track six feet three inches; overall width, seven feet.

The steering-gear is made so that the vehicle will turn round in a radius of twelve feet measured on inner rear wheel. There are two sets of brakes operated by foot pedal and side lever, one acting directly upon a drum upon the rear wheel and the other on the drum brake on countershaft. The motors drive through worm gearing a countershaft, from which the rear wheels are driven by means of sprocket wheel and chain.

The interior is fitted with rattan spring seats arranged transversely, all the interior fittings being of polished oak wainscoting.

The length of the line is about 1.25 miles, through a densely-populated district, connecting two street railways already operating. Side poles and span wires have been adopted.

Fig. 1, shows a car passing two trucks and illustrates the extreme reach of the trolleys. Fig. 2 shows the section boxes along the route. A switch panel is in one box, and in the other is a meter registering the supply to the line.

FIG. 1.—RAILLESS TROLLEY CAR PASSING TRUCKS.

Electric Power for Brick Works.

The German Association for the Supply of Electricity last year collected information from seventeen brick works as to power costs and cost of production. The *Deutsche Töpferund Ziegler-Zeitung* published the figures, which were then analyzed by R. Loewenherz for the purpose of making comparisons between electric and steam power (portable engines). The results are very much in favor of electric power. The outputs of the seventeen works ranged from half a million bricks to five million bricks, and it is especially pointed out that increase in the output makes very little difference to the steam-power item, while with electric power the relative cost decreases considerably when the output is increased.

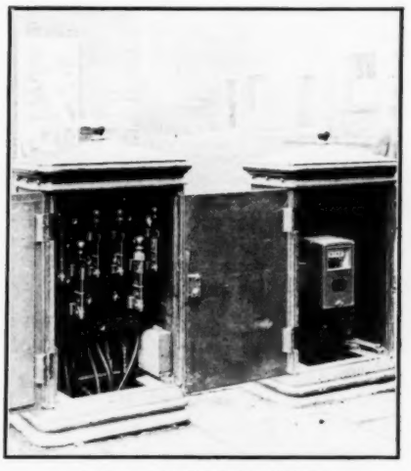


FIG. 2.—SECTION BOXES.

Turkish Warships to Use Wireless.

Marconi wireless apparatus will be utilized on eleven Turkish warships. Four of these will have three-kilowatt apparatus, giving a signaling radius of nearly 400 miles. The other seven will utilize only half as much power.

The land station to be erected at Constantinople is one of twenty kilowatts, using wave lengths of from 650 to 2,200 yards, and covering a distance of 600 miles.

BOOK REVIEWS.

"The Principles of Electro-Deposition." By Samuel Field. New York: Longmans, Green & Company. Cloth, 383 pages (5x7½ inches), illustrated. Supplied by the Electrical Review Publishing Company for $1.80.

This book is particularly suited to those engaged in the art of electro-deposition who desire a more thorough understanding of the underlying principles. In treating these principles the author assumes the reader to have a knowledge of the fundamental principles of chemistry. Details of workshop practice are but briefly treated. Chapter I deals with voltaic cells and accumulators, Chapter II with the properties of electric current. In Chapter III the simple principles of the dynamo have been briefly dealt with. The insight thus given may serve to encourage the student to seek for wider knowledge on the subject. Chapters IV, V, VI and VII deal with the various other electrical apparatus met with in the work, and the remaining chapters are analyses of the art of electro-depositing. A valuable feature of the book is the exhaustive appendix containing tables, formulas, etc.

"High-Frequency Currents." By Noble M. Eberhart. Chicago: New Medicine Publishing Company. Cloth, 303 pages (5x8 inches), illustrated. Supplied by the Electrical Review Publishing Company for $2.00.

This book treats of the practical application of high-frequency electric current in curing and relieving diseases. Several chapters are arranged in handbook form explaining briefly the method of applying high-frequency currents. The early portion of the book contains brief descriptions of the apparatus used and many diagrams are given showing the exact method of applying the various instruments.

"Questions and Answers for Automobile Students and Mechanics." By Thomas H. Russell. Chicago: The Charles C. Thompson Company. Imitation flexible leather, 140 pages (5x7½ inches). Supplied by the Electrical Review Publishing Company for $1.00.

The questions and answers in this book will be found useful by every student and mechanic of motor cars and motoring as a means of reviewing systematic study or in daily work. The more important subjects connected with motor cars are treated individually, there being a separate set of questions and answers for each. Minor subjects are covered in a special catechism, which deals with all the factors which go to make up the power plant of a modern automobile.

"Storage Batteries." By A. E. Watson. Lynn: Bubier Publishing Company. Cloth, 166 pages (5x7 inches), illustrated. Supplied by the Electrical Review Publishing Company for $1.50.

This is the second edition of Mr. Watson's practical treatise on storage batteries. The early portion of the book gives a brief historical outline of the early cells. Several chapters deal with the construction of the plates, setting up a storage battery and the method of constructing a battery. The auxiliary apparatus used in connection with storage-battery installations is described. There is also a discussion of the methods of conducting tests and of the diseases and remedies of storage batteries. The entire book is thoroughly practical and should be of benefit to those having to do with the care and operation of batteries.

"Monoplanes and Biplanes." By Grover C. Loening. New York: Munn & Company. Cloth, 331 pages (5½x8 inches), illustrated. Supplied by the Electrical Review Publishing Company for $2.50.

In this book the author has presented the subject of the aeroplane in a manner that is at once intelligible and of interest to the average man, as well as of value to the more learned student. After a historical introduction the design of aeroplanes is taken up. The theory of aerodynamics is given as simply and completely as possible. The monoplanes and biplanes in their various forms are considered, detailed descriptions of virtually all of the present successful types being given. The text is supplemented with photographs and diagrams, reproduced to the same scale, thus enabling a graphic comparison. In the last part of the book the leading types are compared and discussed.

"The Foundations of Alternate Current Theory." By C. V. Drysdale. New York: Longmans, Green & Company; and London: Edward Arnold. Cloth, 300 pages (5x8½ inches), illustrated. Supplied by the Electrical Review Publishing Company for $2.50.

This book consists of a course of lectures given by the author to his classes, and in it complicated mathematics has been avoided, nothing more than a knowledge of algebra and simple trigonometry being assumed upon the part of the reader. Mechanical analogies of electrical phenomena have been extensively followed, and many illustrations of models for explaining these relations are given. The book deals entirely with the fundamental relations and does not attempt to consider applications, but only to give a clear conception of the basic facts and relations. In this it will no doubt prove eminently successful.

Congress of Technology Papers.

It is announced that the *Proceedings* of the Congress of Technology, held in Boston April 10 and 11, are to be published. The single volume of about 500 pages, which will be sold at a moderate price, will contain about seventy technical papers, relating to many fields of industry, which were read at the celebration of the fiftieth anniversary of the granting of the charter of the Massachusetts Institute of Technology.

Annual Report of Electrical Operations, Sanitary District of Chicago.

The annual report of the electrical department of the Sanitary District of Chicago has been made public. It relates to the year ended December 31, 1910. The income for the year from the sale of power and light was $562,546.46, which is an increase of $178,981.77 over the preceding year. Other items brought the total income to $573,550.26. Operation and maintenance of the Lockport generating station was $30,645.90, of the transmission system and substations, $52,101.33, of the distributing system $22,827.42, of the utilization service (chiefly operation at consumers' and municipal substations) $11,896.22, of the commercial and promotion (new business) department $11,062.51; the general and miscellaneous expenses were $122,762.39 and the total operating expenses $251,295.77. The net earnings, therefore, were $322,254.49.

The fixed charges were figured as a total of $200,755.03, including $30,298.43 for taxes, $169,962.08 for interest (less than 4 per cent) on cost of plant and equipment, and $494.52 for rental of leased lines. The net profit on the year's operations was, therefore, $121,499.46. It is interesting to note that the depreciation charge of $75,682.57, which was included among general and miscellaneous operating expenses, is considerably less than two per cent of the entire cost of plant and equipment, which is given a book value of $4,590,091.83 in the assets.

Sixteen municipal bodies in and near Cook County purchased current from the Sanitary District, the City of Chicago being the largest consumer with a total of $146,106.07.

FINANCIAL REPORTS OF ELECTRICAL COMPANIES.

AMERICAN POWER & LIGHT COMPANY.

The American Power & Light Company, comprising the Kansas Gas & Electric Company, the Pacific Power & Light Company, and the Portland Gas & Coke Company, recently issued a report for the year ending May 31, 1911. The balance sheet follows:

ASSETS.

Stocks and bonds		$10,079,139.17
Furniture and fixtures		2,045.96
Notes receivable		2,117,552.05
Accounts receivable		102,633.69
Prepaid accounts		614.53
Suspense accounts		16,031.29
Cash		13,756.88
Total		$12,331,773.57

LIABILITIES.

Capital Stock:		
Preferred	$3,070,300.00	
Common	5,631,400.00	
		$8,701,700.00
Notes Payable:		
Electric Bond & Share Company	$1,954,393.57	
Sundry	1,053,933.33	
		3,008,326.90
Accounts payable	$ 337,790.44	
Accrued interest payable	13,104.01	
		350,894.45
American Power & Light Company, Trustee		4,339.72
Reserve		24,330.77
Surplus		242,181.73
Total		$12,331,773.57

BELL TELEPHONE SYSTEM IN UNITED STATES.

The American Telephone & Telegraph Company, and associated holding and operating companies, not including connecting independent or sub-license companies, report for the five months ended May 31, 1911, with all duplications, including interest, dividends, and other payments to the American Telephone & Telegraph Company excluded, compared as follows:

	1911.	1910.
Gross revenue	$72,710,093	$66,831,950
Expenses and taxes	28,357,638	24,746,815
Balance	44,352,455	42,085,135
Maint. and depreciation	23,109,264	21,745,550
Net revenue	21,243,191	20,339,585
Interest	5,727,507	4,571,732
Net income	15,515,684	15,767,853
Dividends paid*	10,479,243	10,647,298
Surplus	5,036,441	5,120,555

*Dividend payments for April and May are estimated.

Mexican Companies Prosper.

The Mexican Light & Power Company, the $40,000,000 Canadian concern which owns the large hydroelectric plant at Necaxa, state of Puebla, and which furnishes electric current to Mexico City and the El Oro and Pachuca mining districts, reports gross earnings of $2,710,255, Mexican currency, for the first four months of this year. This is an increase of $616,109 compared with the earnings in the corresponding period of 1910. However, there was an increase of $454,153 in operating expenses, the total for the four months being $956,605. The net earnings were $1,753,650, an increase of $161,956. The Mexico Tramways Company, operating the trolley lines of Mexico City and controlled by the Mexican Light & Power Company, shows gross earnings for the first four months of 1911 of $2,005,198, Mexican currency, and net earnings of $1,033,451. The gross earnings increased $208,597, and the net earnings $110,792. D.

J. G. White & Company, Ltd.

The twelfth ordinary general meeting of J. G. White & Company, Ltd., was held recently in London, England, with Mr. White presiding.

As presented, the report showed that the net profit for the year amounted to £91,466, as against £64,801 last year. Not only was this profit by far the largest ever shown by the company, but the increase over the preceding year was also the largest ever made. It was not to be expected that profits so large could be realized every year, for the results of the period under review had exceeded even the directors' expectations. At the same time, they still considered the position of the business in hand as being quite satisfactory, and the outlook most encouraging. It would be noticed from the balance sheet that the quick assets of the company, in the form of cash and loans against securities, amounted to £136,331, being an increase of about £18,000 over the figures shown in the preceding year. The quick-asset item was nearly double the total single creditor item on the other side of the balance sheet, although this latter item included certain considerable contingent provisions; so that this cash, and practically cash item, was more than double the actual total debts. The investments stood at £150,781, which was also considerably more than twice the company's total debts.

The directors recommended a dividend of seven per cent for the half-year on both the preferred and ordinary shares, making, with the interim dividend of five per cent, paid January 1, a total distribution of twelve per cent for the year. They further recommended an extra dividend of ten shillings per share, or fifty percent, on the ordinary shares, making a total of sixty-two per cent for the year, leaving a balance of £19,812 to be carried forward.

AMONG THE CONTRACTORS AND SUPPLY MEN

THE PLUMBING & ELECTRIC COMPANY, of Normal, Ill., was formed by Lee Stuart and Ralph Stuart, and will do general contracting work.

THE ELLIS ELECTRIC COMPANY has opened an electrical supply store at 1834 D Street, Granite City, Ill., under the management of Harry Perry.

THE BARRE ELECTRIC COMPANY, Montpelier, Vt., has been organized to do all kinds of electrical contracting work, etc. The members of the new firm are C. S. Cushman, P. M. Carr and C. K. Coles.

WALLACE & KAVANAUGH, of St. Charles and Aurora, Ill., have been awarded the contract for wiring, fixtures and all electrical work for the Soldiers' Home in Wilmington, Ill.

THE ELECTRIC CONSTRUCTION COMPANY, of Lake Charles, La., which was incorporated a short time ago, will handle electric fixtures and will do all kinds of contracting work. The president of the company is J. Stuart Thomson.

LEICHNER & WEISHAR, of Rock Island, Ill., have just been awarded the contract for wiring the Longfellow School and new addition in that city. The job consists of conduit work throughout, the contract price being $945. Work is under way and is to be completed the latter part of August.

THE JOHN S. NOEL COMPANY, Grand Rapids, Mich., received the contract for installing a lighting system and supplying fixtures for the new St. Mary's Hospital in that city. The operating room is lit by sixty-watt tungsten lamps arranged in the form of a large circle, so that shadows are practically eliminated.

THE ARNTSEN-McFALL ELECTRIC COMPANY, of Minneapolis, which was organized last January by B. E. Arntsen and W. J. McFall to do electrical contracting, has been awarded the contract for wiring the new Syndicate Building in that city. Work has recently commenced and is to be completed by January 1, 1912.

Exports of Copper.

Exports of copper for the week ended June 13 were 8,241 tons. Since July 1, the amount is 13,942 tons.

New Electrical and Mechanical Apparatus and Appliances.

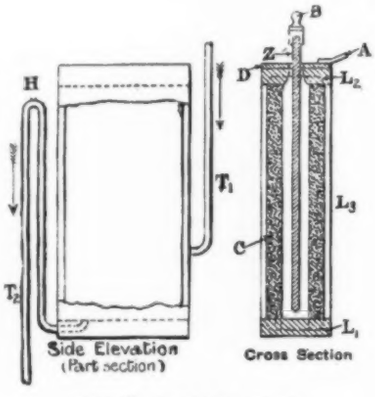
The Benkö Cell.

In the primary battery invented by Stephen Benkö, a Hungarian engineer, the essential principle is that if the layer of electrolyte on the positive plate is removed as fast as polarization sets in, the electromotive force will be maintained constant.

The means usually adopted for removing polarization, which is responsible for most of the trouble in primary cells, are rarely quite effective; and the ineffectiveness of the means becomes more and more evident as the solution becomes exhausted through the action of the cell. The user would not object so much to polarization in itself if it would remain sensibly constant, but this is seldom the case. The remedy adopted by Mr. Benkö is to use a carbon electrode sufficiently porous to allow the electrolyte to flow through it, thus continually providing a fresh supply to the surface that is tending to polarize. By so doing, not only is very effective polarization obtained (depending, of course, upon the depolarizing qualities of the solution and its rate of flow), but for a given current the polarization remains quite constant provided the cell is not overloaded.

The method of putting this idea into practice will be understood most readily by a description of the cell as at present made. For the sake of clearness the construction is indicated diagrammatically in the accompanying illustration. Here the carbon is shown at C, and this is best described as a flattened cylinder open at both ends. The hard surface of this carbon, as received from the carbon makers, is removed by scratch-brushing so as to leave it easily porous. The carbon is then provided with a lead cap, L_1, at the bottom, and a lead ring L_2 at the top, thus providing a vessel open only at the top. To obtain perfect contact between the carbon and the lead, the latter is put on under pressure by the simple expedient of holding the carbon in a suitable iron holder and dipping it to a depth of two metres in a bath of molten lead. Under this pressure the lead penetrates thoroughly into the pores of the carbon and, consequently, an exceedingly good contact is obtained, the process taking a quarter to half an hour according to the thickness of the carbon. The iron holder is provided with formers, so that sufficient metal is taken up to form the cap and ring complete in this one operation.

A lead shell, L_3, of sheet lead is then fitted round the carbon, leaving a small space between the carbon and the shell, and is jointed autogenously to the lead cap at the bottom and the lead ring at the top, so as form a chamber all round the carbon. There are thus two chambers, one inside the carbon and one outside. The outer chamber is provided with a tube, T_1; and a second tube, T_2, is fitted to the lead base and is carried through to the inner chamber. This latter tube is carried up and bent over, and there is a small hole, H, at the top of the bend. Finally a copper plate, D, corresponding with the lead ring, is soldered on to the lead, and forms one terminal, A, of the cell. In later designs this copper plate has been abandoned, the terminal being jointed direct to the lead ring. The zinc, Z, is inserted into the inner chamber and carries the second terminal, B. When in action the electrolyte is delivered by the lead tube, T_1, into the outer chamber, whence it percolates through the carbon to the zinc; it then flows off through the lead Tube, T_2, the form of which maintains the level constant within the carbon. As there is a hole at H, syphoning does not occur, though this may be made to take place in cells so constructed by closing the hole with a finger for a few minutes. This is often convenient when it is desired to empty the cell. It will be noticed that the current is carried away from the carbon at both top and bottom, and owing to this form of construction, and to the excellent contact between the carbon and the lead, very much heavier currents can be taken than is possible with the usual form of joint.



BENKÖ PRIMARY CELL.

The space provided between the carbon and the lead shell is very small. The lead, however, gives somewhat under the pressure of the electrolyte, and for that reason it is supported by a wood casing (not shown). The zinc plate is carried in an ebonite frame. The tubes T_1, T_2, are provided with unions and rubber washers, for coupling to other tubes as may be found necessary.

New Indicating Boiler Flow Meter.

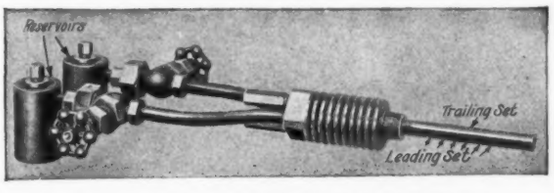
The betterment of station economy demands not only the employment of well-trained firemen and properly designed fire tools, but also the use of such instruments as recording pressure gauges, feed-water thermometers and steam-flow meters, to furnish the information by means of which alone high efficiencies and economical results can be obtained.

The new FS-2 boiler meter developed by the General Electric Company is designed to indicate the total amount of steam generated at any instant by a boiler or a battery of boilers in pounds of steam per hour, or in boiler horsepower. Therefore, it can be advantageously used for obtaining data for equalizing the load on individual boilers or a battery of boilers; for determining the efficiency in the method of stoking, or the correct feed-water circulation; for determining the deterioration in efficiency due to the formation of scale; for discovering internal leaks as shown by the difference in water input and steam output; and for indicating the amount of steam distributed to different departments of a manufacturing plant, or the amount used in various manufacturing processes. In other words, it constitutes a valuable aid to engineers and firemen in maintaining an intelligent oversight of the fireroom.

For example: the accompanying record shows the fluctuations in the amount of steam generated by a 650-horsepower boiler in a large central sta-

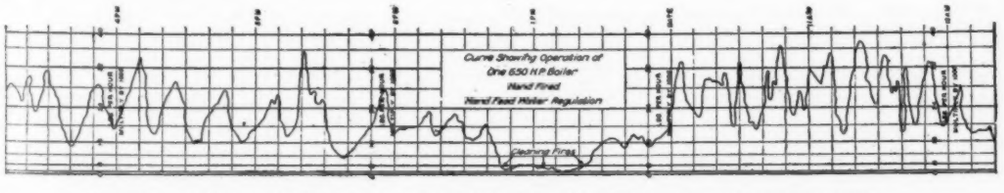
tion operating turbo-generators carrying a lighting load. The boiler is one of a battery of six, hand fired, hand feed-water regulated, and was supposed to be constant flow. The record shows, however, that the flow was irregular to a degree entirely unwarranted by the character of the load. Consequently, it is more than probable that

STEAM-FLOW METER.



NOZZLE PLUG AND PIPING FOR METER.

the inefficiency was due to improper handling of the fires and to incorrect feed-water regulation. It is obvious that this information could have been obtained by means of an FS-2 boiler meter, and furthermore, that the use of the meter would have prevented the occurrence of the conditions shown on the record, since it would have indicated the load at all times and thus enabled the fireman to hold the same at a given point.



METER RECORD SHOWING FLUCTUATIONS IN AMOUNT OF STEAM GENERATED.

The meter apparatus complete consists of a nozzle plug, the meter proper and the necessary pipes for connecting the nozzle plug to the meter.

The nozzle plug is similar to those used with the general line of steam, air, and water flow meters manufactured by the General Electric Company. It consists of a screw plug, provided with a stem having two sets of orifices—a leading set arranged longitudinally and a trailing set comprising three holes, located at the middle of the stem and at right angles to the leading set. The interior of the stem is divided longitudinally into two separate compartments, the leading set of orifices opening into one, and the trailing set opening into the other.

For operation, the nozzle plug is screwed into a small hole drilled and tapped in the steam pipe, with the stem extending across the pipe and the leading set of orifices facing the direction of steam flow. When thus arranged, the velocity of the steam causes a certain difference of pressure to exist in the two sets of orifices, and this difference of pressure is communicated through suitable pipes connecting the compartments in the nozzle-plug stem with the U-tube of the meter.

The body of the meter consists of an iron casting cored out to form one leg and the well of the U-tube, the other leg being formed by one of the nozzle-plug connecting pipes entering the well at the opposite end. The well is filled with mercury, and the rest of the apparatus, including the connecting pipes and the compartments in the nozzle-plug are filled with water.

The movable mechanism of the meter comprises a small float resting on top of the mercury in one of the legs of the U-tube, and attached to a waterproof silken cord passing over a pulley and held taut by means of a counterbalance weight acting on the pulley in the opposite direction, and a pair of horseshoe magnets—one inside the meter, attached to the pulley shaft, the other outside the meter, fixed to the pivoted end of the indicating needle. The axes of rotation of the two magnets are in line and their mutual attraction exerted through a copper plug screwed into the side of the meter body casting compels them to move in unison.

When the difference of pressure caused in the nozzle plug by the velocity of the steam flowing in the steam pipe is communicated to the two legs of the U-tube, the mercury in the well rises or falls in the leg containing the float to a height proportional to the difference of pressure. The resulting motion of the float rotates the pulley, and the motion of the latter is transmitted through the pair of magnets to the indicating needle. The employment of the pair of magnets obviates the use of the troublesome packed joint which would be necessary for transmitting the motion of the pulley inside the meter to the indicating needle on the outside, by means of any form of mechanical connection.

The meter is easily installed, without interfering in any way with existing steam-pipe arrangements. The work of installing merely requires the drilling and tapping of a small hole in the steam pipe for the insertion of the nozzle plug. The design of the latter permits of its insertion in pipes running either vertically or horizontally. Care should be taken however, to select a straight run of pipe of at least twelve pipe diameters in length. The meter itself can be located in any desired place, so long as it is kept below the nozzle plug. Its distance from the nozzle plug is immaterial, and it should be connected to the same with 0.25-inch iron pipe of the required length. The best location is on the front of the boiler near the steam gauge, in plain view of the fireman and the engineer.

The dial scale is eight inches in diameter, marked with heavy flow lines

and large figures on a white surface, for easy reading. A target of conspicuous size is provided for designating a certain flow on the scale. This target can be readily set from the outside.

The meter can be calibrated to read in pounds per hour or in boiler horsepower (thirty pounds of steam per hour being taken as equivalent to one boiler horsepower), for pressures ranging from 0 to 250 pounds, gauge; for quality ranging from four per cent moisture to 260 degrees Fahrenheit superheat; and for pipe diameters of 2, 3, 4, 6, 8, 10, 12 and 14 inches. Meters calibrated for pipes larger than fourteen inches in diameter can be furnished on special order.

It will be noted in this connection that for any given case a meter of this type is calibrated for a certain pressure, quality and pipe diameter.

Automobile Instruments.

The new automobile volt-ammeter, type DK-3, has been designed by the General Electric Company to meet the requirements of automobile manufacturers for a very small instrument, which can be placed inside the car, and not be in the way. This instrument has two D'Arsonval elements of the most

AUTOMOBILE VOLT-AMMETER.

modern design and possesses all the valuable features of the permanent-magnet instruments of this type. The ammeter is a millivolt-meter operating from an external shunt connected in series with the circuit; the voltmeter is self-contained, the series resistance being placed within the case. The scales are illuminated by a two-candle-power lamp. Lamps of different voltages are available to suit the normal voltages of the various batteries used. Six terminals located in the base are so arranged that the wiring can be installed and the instrument placed in position after putting on the upholstering of the car. This is of great advantage, as such instruments should never be placed on a car until practically all other work is finished.

TELEPHONE TRAIN-DISPATCHING APPARATUS.

LISTENING SETS.

One of the advantages of the telephone for train dispatching is that it permits any official of the road to listen upon the circuit at his pleasure and to observe the grade of the service being given by the telegraph department. It has been found as a matter of fact that it soon becomes known to the operators that this can be done, and is done, and thereby has a very beneficial influence in improving the service.

The Western Electric Company, manufacturers of a complete line of telephone train-dispatching equipment, has designed and placed on the market a very neat sole-leather listening outfit especially for this purpose. The set is so small that it can easily be carried in a man's pocket, and merely contains a receiver, condenser and the necessary cords and clips for attaching it to the line.

The No. 18-A test set, as this apparatus is known, is in use on a number

NO. 18-A TESTING SET.

of roads at the present time among the officials. With it they are able to connect the receiver to the line at any station where they may happen to be without interfering with the regular operator and without anyone knowing that they are upon the circuit.

FOOT SWITCHES.

On telephone train-dispatching circuits, the stations are all connected to the same wires, and there may be on such a line any number of telephone sets up to sixty or seventy. For conditions like this, where it is possible for any number of these stations to be listening in upon the circuit simultaneously, and where quite frequently from four to six stations are called in to receive orders, special high-efficiency transmission apparatus is required.

The Western Electric Company, whose circuit for this purpose is in use on many of the railroads in the United States employing the telephone for dispatching, has solved this problem by the use of a switching device. In the normal position of this switch the most efficient circuit for receiving is obtained, and when the switch is thrown the most efficient circuit for transmitting is cut into service.

At many stations it is considered preferable to have the operator work this switch by his foot, rather than to use a key which he must throw with his hand. The advantage of the foot switch is obvious, in that it leaves both hands free for other purposes.

This foot switch is shown in the accompanying illustration as it is mounted in the office. It consists merely of a cast-iron case in which the switch springs are mounted and from which a lever projects to operate the springs.

Another advantage of the foot

NO. 1-A FOOT SWITCH.

switch is that it makes for greater speed in the use of the telephone apparatus. For this reason it is largely used in connection with the special types of telephone arms with which an operator does not have to put on any head set nor touch any receiver. These arms were specially designed for use in interlocking towers, where the operator is obliged to get away from the telephone quickly to handle his levers, and these arms, in combination with the foot-switching device above described, form a most efficient telephone equipment for train-dispatching service.

FIVE NEW TELEPHONE CIRCUITS FOR CHICAGO & NORTHWESTERN RAILWAY.

The Chicago & Northwestern Railway, which has been using the tele-

phone for dispatching trains on several of its divisions for some time past, has just placed an order with the Western Electric Company for telephone selectors to equip five new circuits. The number of selectors used on these circuits will be 130 and the length of circuits will be over 600 miles.

The circuits to be equipped are one on the Fremont Division, two on the East Iowa Division and two on the Dakota Division. The Fremont circuit will be equipped with twenty-two stations and will run between Fremont, Missouri Valley, Omaha and South Omaha. The East Iowa Division is divided into two circuits, the dispatcher for each being located at Belle Plaine, Iowa. One circuit extends from Belle Plaine to South Clinton, a distance of 116 miles, and is equipped with thirty-one selectors; the other extends from Belle Plaine to Boone, Iowa, a distance of eighty-seven miles, and is equipped with twenty-three selectors.

One of the Dakota circuits will run from Huron to Brookings, the distance covered by this main circuit and branches being 170 miles. The dispatcher will be located at Huron, and the circuit will be equipped with thirty-six stations.

The second Dakota circuit will run from Huron to Tracy, a distance of 163 miles. This circuit will be equipped with twenty stations and the dispatcher will be located at Huron.

RESULTS ON PERE MARQUETTE RAILROAD.

About a year ago it was thought by the officials of the Pere Marquette Railroad that if they installed a telephone train-dispatcher's circuit on their line between Saginaw and Toledo they would be able to avoid the regular yearly expense and inconvenience of splitting the division and putting on an extra set of dispatchers during the busy season.

After a careful investigation and a thorough study of their conditions compared to similar conditions on other roads, it was concluded that the experiment was worth while, although the expense would be considerable. Accordingly, the line was put up and equipped with the latest type of selectors and telephone equipment.

As this piece of track was about as busy as any single track to be found anywhere, speed of operation was one of the features to be considered. Because of its high speed of operation and superior efficiency the Western Electric selector was specified and put in on trial. The performance of this equipment thoroughly met the requirements of the service and not only eliminated the necessity of an extra set of dispatchers but made the work of the dispatchers easier during the rush than ordinarily during the dull seasons.

Some of the savings effected here can be easily computed, and in the dispatcher's office alone enough was saved in operation to pay a good rate of interest on the total cost of the circuit.

The saving in overtime of train crews cannot be readily estimated, as so many things enter into such a proposition. The increased traffic made possible by eliminating order delays is another feature not readily computable. This is a very important factor on any road that is at all busy, and when the road is working near the limit, as in the case of this division, it means an increased revenue at a reduced cost of operation.

The apparatus used on this dispatcher's line is shown in the accompanying illustrations. Fig. 1 shows the dispatcher's office, which is very conveniently and efficiently arranged.

It will be noted that the dispatcher's room here is separated from the telegraph office by a glass partition, thus taking away all the tendency to distractions.

The way-station equipment, shown in Fig. 2, is an excellent example of way-station apparatus and requires no comment other than the convenient location selected.

The operation of the apparatus is pronounced by the railway officials as perfect. In fact, the experiment on this division has proven so successful that three more circuits are being installed at present, and it is the hope of the operating officials to complete the installation of telephone train dispatching over the entire system at an early date.

In addition to the regular equipment for train dispatching, this circuit is equipped for a simplex telegraph circuit from Saginaw to Plymouth, connecting to the Detroit wire.

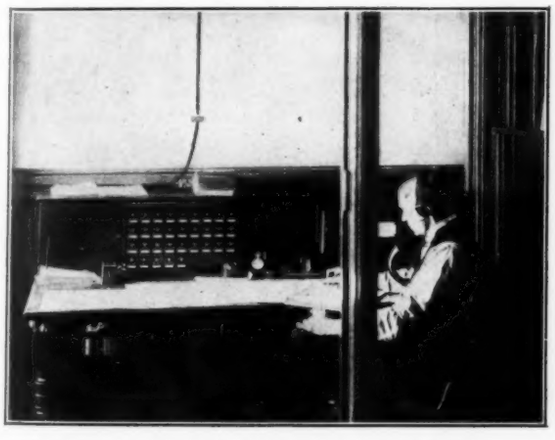


FIG. 1.—TRAIN-DISPATCHER'S EQUIPMENT.

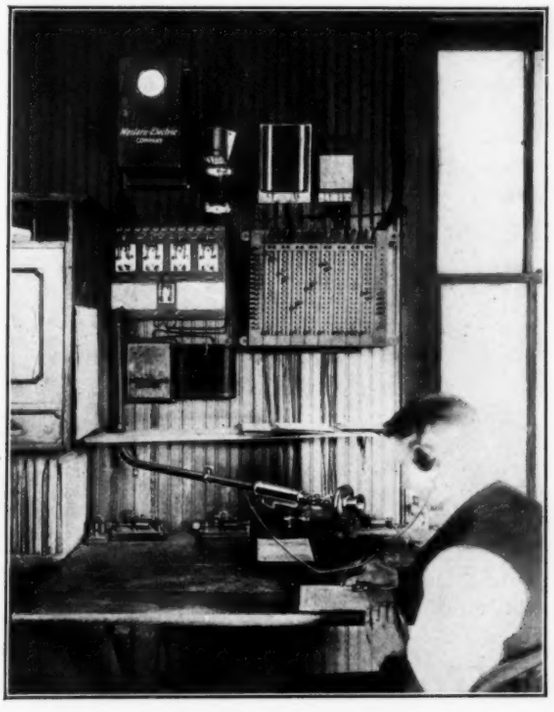


FIG. 2—WAY-STATION EQUIPMENT.

Alternating-Current Switchboards of Small Capacity.

The increasing demand for alternating-current switchboards of moderate capacity and price is shown by the popularity of the line of JB panels manufactured by the Westinghouse Electric & Manufacturing Company. This line has been extended to cover a wide range of switchboard applications, and is fully described in catalog No. 704, which has just been issued.

Type JB panels are particularly adapted for use in small central stations and isolated plants operating at voltages between 1,100 and 3,300. This type of switchboard embodies all the essential features required for satisfactory operation. Each panel consists of a marble slab, containing the controlling and indicating apparatus, which is mounted on a gas-pipe framework.

The framework is composed of two 1.25-inch gas-pipe uprights, each fitted with flanges for bolting to the floor, and connected at the top by a continuous wrought-iron strap which runs the full length of the switchboard framework. This construction insures perfect alinement of the panels and rigidity of construction. Pipe sockets for wall braces are supplied with the frame. The total height of the frame is about seventy-six inches.

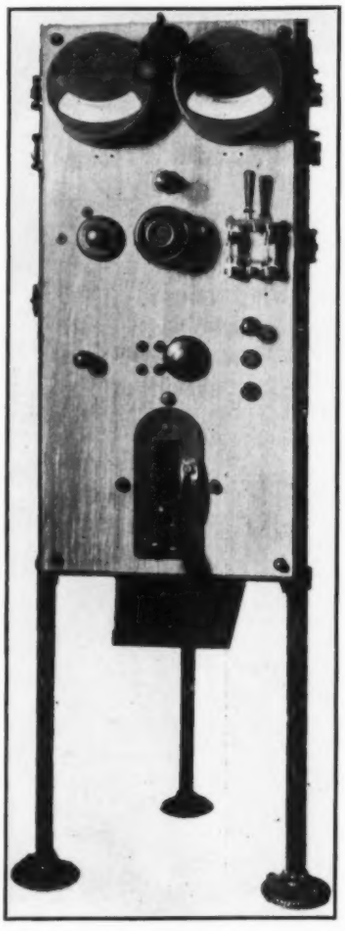
The marble panels are 48 inches high, 1.5 inches thick with three-eighths-inch bevel on the front edges. The width depends upon the amount of apparatus to be mounted on the panel, and varies from 16 to 32 inches.

The finish of the marble is black marine, which is a dull lusterless black, giving a uniform appearance to all panels, and it is not affected by oil.

The instruments furnished with this type of switchboard are Westinghouse type-K ammeters and voltmeters, utilizing the principle originated by Lord Kelvin. The voltmeter is used either to indicate voltage of the circuit or to determine the extent of a ground. This is accomplished by means of a combined voltmeter and ground-detector outfit, consisting essentially of plug switches and a voltage transformer. This device eliminates the extra expense of a special ground-detector instrument. A non-automatic oil switch is recommended for the control of the generator circuit.

Three styles of feeder panels are listed, having respectively the following equipment: (1) Non-automatic oil switches, with fuses mounted on the panel; (2) non-automatic oil switches, without fuse protection, fuses to be provided by the customer; (3) automatic oil switches, eliminating the necessity of fuse protection.

The panel sizes and detail parts are such that they can be packed for mule transportation, making this type of switchboard preferable for installation



ALTERNATING-CURRENT SWITCHBOARD.

in places which are not readily accessible for larger panel construction.

A complete wiring diagram is furnished with each switchboard to aid in installing the equipment.

Wheeler Dry-Tube Condensers for the Terre Haute, Indianapolis & Eastern Traction Company.

The condenser proper, furnished for this installation, is a Wheeler dry-tube condenser with rectangular shell, having two exhaust-steam inlets at the top. It contains 18,000 square feet of surface, comprised of one-inch, eighteen-gauge B. & W. tubes, arranged in two passes. The tube surface is further arranged in a number of banks so distributed that the exhaust steam to be condensed comes in contact with practically all of the surface, in contrast with condensers of older types where the upper banks of tubes do most of the work. Interposed at different levels in the condenser shell are dry plates of proper size and shape to catch the condensed steam and drain it off to the hotwell without its coming in contact with the lower tubes which would cool it and therefore make it less valuable as boiler feed. Another important function of these plates is to prevent the lower tube surface from being flooded with water and therefore impaired in heat transmitting capacity. The surface in the lower part of the condenser is dry just as well as that in the upper and is just as effective in condensing steam.

Condensers of the Wheeler dry-tube type have shown on tests, heat transmissions of as high as 500 to 700 British thermal units per square foot of heating surface per hour, per degree difference in temperature between the steam and the water, as against transmission of two or three hundred obtained in older types of condensers.

In accordance with the generally recognized advantages of counter-current arrangement, the cold condensing water enters in this condenser at the bottom pass, flowing the length of the tubes, turning and coming back through the upper bank and thus out to the discharge. The circulating pump is a Wheeler thirty-inch single-stage pump, driven by a 16 by 18 Cooper Corliss engine.

A hotwell at the lower part of the condenser shell collects the condensate, from which it is pumped by a four-inch vertical motor-driven centrifugal hotwell pump. Air is removed from the condenser by a Westinghouse Le Blanc air pump.

The King Electric Washer.

In the King electric washer a long step has been taken in the direction of simplifying the construction of the washing machine. This machine is thoroughly efficient as a washer, and has nothing in its construction to get out of order; moreover, it retails at a reasonable price.

The King washer is a cylinder machine. The clothes are washed by tumbling them around within the cylinder, which is revolved inside a metal tank filled with hot suds. The cylinder is

driven by a motor and does not change its direction of rotation. Linen can be washed in ten minutes without damage to the finest fabrics. Blankets and heavy goods can be washed with equal success. The cylinder has ample capacity for the needs of the ordinary-sized family.

The transmission machinery is very simple in design, consisting of but one pulley and one gear. The pulley is belted to the motor pulley. By means of a simple lever the transmission gear can be thrown from cylinder to wringer, as desired. There is no raising or lowering of the cylinder to engage the gears, and when the transmission gear is in the wringing position the cylinder can be lifted out. All gears are completely protected so that accidents are impossible.

KING ELECTRIC WASHER

The wringer is also driven by the motor. It has ball-bearings and is so arranged that the rolls are automatically thrown out of gear if they become stuffed; this arrangement prevents the motor from becoming overloaded. When not in use, the wringer can be dropped down at the side of the washer, and the machine then forms a convenient table and not an obstruction in the kitchen or laundry. All parts of the machine are of the highest quality. The metal parts are heavily galvanized and the frame is very strong and rigid.

The motors used are made by the Westinghouse Electric & Manufacturing Company. In these motors every precaution has been taken to prevent trouble due to water and moisture. Their capacity is sufficient to carry all overloads not taken care of by the releasing mechanism of the machine itself. The motor can be run from any electric light socket. The manufacturer of the King electric washer is the Rex Manufacturing Company of Johnstown, Pa.

Wood Preservation.

To protect wood from decay the cellular tissue must be protected from the invasion of the decay germs, or it must be so altered by chemical change that it will no longer be a suitable medium of germ culture. It was long ago discovered that certain chemicals had the property of protecting wood from decay, but the trouble has been to bring them into sufficient contact with the cellular tissue of the wood and then to make the contact a permanent one.

In order that this may be done the substance must not evaporate at ordinary temperature nor be soluble in water, hence aqueous solutions of antiseptic chemicals will not avail when the treated wood cannot be protected from moisture; neither will the light oils give more than temporary protection, even when combined with the powerful antiseptic coal-tar acids, for, in a short time, they evaporate and the temporary protection ceases.

From this it may be easily seen that the heavy oils, insoluble in water, that do not evaporate at ordinary atmospheric temperatures, combined with powerful chemicals which are germicides, must be the ideal and rational process of preserving wood. There is no doubt about the efficiency of such a combination, for nearly a century of experience has proved it. This efficient combination is found in Cop'R-oiL carbolineum, sold by C. S. McKinney Company, 50 Church Street, New York, N. Y.

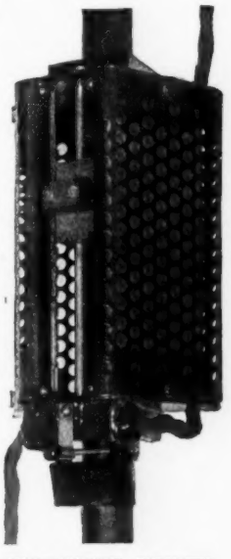
To efficiently preserve wood the preservative must penetrate the wood, must make the tissue of the wood proof against the destructive growth which causes decay and must be of such a nature that its protective effect will be permanent.

Cop'R-oiL carbolineum is a heavy oil that penetrates the wood and makes the tissue proof against the fungus growths because it is highly antiseptic. Its effect is permanent because it will not evaporate at ordinary atmospheric temperatures and, being absolutely insoluble in water, it cannot be washed out of the wood. The oil used is a product of the fractional distillation of coal tar.

The highly antiseptic quality of Cop'R-oiL carbolineum makes it a great promoter of cleanliness. Its odor and taste are repulsive to vermin and insects. The antiseptic quality is not temporary, but lasting, as it does not evaporate or wash out.

Cutler-Hammer Spot-Light Dimmer.

A new spot-light dimmer for use with portable incandescent spot-lights has been put on the market by the Cutler-Hammer Manufacturing Company, Milwaukee, Wis. This dimmer is not of the type of the Simplicity dimmer plates made by this company, but is designed especially for use with portable spot-lights.



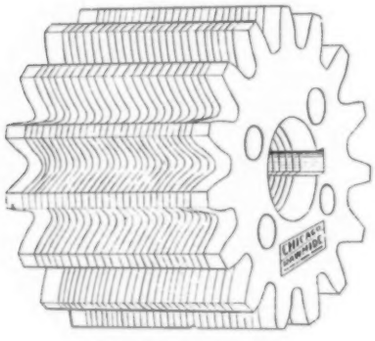
SPOT-LIGHT DIMMER.

When installed it partly embraces the upright pipe standard of the lamp (shown at top and bottom of illustration) to which it is clamped. This dimmer takes up a minimum amount of space, does not project bulkily and has no exposed live parts. The fiber handle travels on a guide rod in a slot in front of the frame, and the contact buttons are on the inside, mounted directly upon the units by through screws. They are, therefore, directly connected to the resistance wire.

The weight is only a little over five pounds and the over-all height only ten inches. Twenty steps and an "off" point are provided.

Rawhide Pinions.

The idea of constructing a gear wheel of rawhide was conceived by the late D. R. McCutcheon, and the first one was constructed in 1881 in the factory of the Chicago Raw Hide Manufacturing Company. This rawhide pinion was made to replace a metal one which was giving considerable annoyance on account of noise. The experiment proved highly successful and led to the use of rawhide pinions in other apparatus. It was not, however, until the coming of direct electrical drive that rawhide pinions came into general use. Then their superiority over metal in gear drives was soon recognized. As a non-conductor rawhide has an advantage around electrical machinery, and in addition its flexibility relieves machines of the vibration due to jar, which is common with metal gears, and there is consequently a saving in the cost of repairs and renewals. In running under favorable conditions at high speed a rawhide pinion will outwear one of iron, brass or steel, and as it takes nearly all the wear, the life of the meshing gear is greatly prolonged.



RAWHIDE PINION.

The value of a rawhide pinion depends primarily upon the fibrous strength of the hide from which it is made, and great care must be exercised in the selection of the rawhide blank for this purpose. It is claimed that Chicago rawhide blanks have more layers to the inch than any other on the market. Every layer means additional strength. Some rawhide is prepared by the use of lime, which fills the hide and distends the fibers, giving an increase in weight but a sacrifice of strength. The accompanying illustration shows a rawhide pinion with brass flanges.

The Chicago Rawhide Manufacturing Company has been making a specialty of rawhide for mechanical purposes since 1879. The old plant was totally destroyed by fire in January, 1910. The present factory at 1301 Elston Avenue, Chicago, Ill., is equipped with the most modern machinery.

New Process for Making Steel-Reinforced Cement Poles, Tubes and Pipes.

A contract has been entered into by an American concern for the purchase of all patents and rights for the United States appertaining to the use of the "Schleuder-Röhren," or centrifugal process for the manufacture of steel-reinforced hollow tubes, pipes, poles, piles, and like products.

Over 5,000 poles for telephone and telegraph use have been supplied for state, city, and private requirements in the cities of Dresden, Prague, Leipzig, and many other localities of Germany and Austria; sewer pipe manufactured by this process has been used in the new state railway station at Leipzig, for mine timbering in Silesia, and for other work. It has proved cheaper in first cost than iron or steel and somewhat higher than wood, but in view of the elimination of practically all operating, repair, and replacement costs, its advantages over wood are obvious.

The process consists of filling a hollow reinforcement of steel rods and wire, made on a machine, with a patented composition of cement, sand and asbestos in established proportions. Drying is accomplished by whirling in the centrifugal machine for eight to ten minutes at the rate of 1,000 to 1,500 revolutions a minute. The pole or pipe is then taken out for further weather curing or hardening. The great centrifugal force exerted by the high revolving speed extracts the water used in mixing and creates a uniformity of density and strength of concrete impossible in the stamping, pressing, or other machine or hand processes now in use.

Poles up to forty-six feet in length and sixteen inches in diameter have been regularly made, but the machines now building will increase both dimensions if desired, and are adjustable to lesser dimensions.

Extensive Developments in Maine.

The Penobscot Chemical Fibre Company, Great Works, Me., recently secured control of power rights on the Penobscot at Orono, and the concrete dam for this development, which will be ultimately about 65,000 horsepower, has been designed by Hardy S. Ferguson, consulting engineer, of New York City. This year the company is building the abutment and a 100-foot length of the dam. On June 1 the Aberthaw Construction Company started the construction of the eight new concrete flumes at the main works. At the present time there are four flumes in operation and the eight new ones will furnish electric power for bleaching purposes.

A Unique Screw-Driver.

The accompanying illustration shows a new screw-driver which has been placed upon the market by the Benjamin Electric Manufacturing Company, Chicago, Ill. In this screw-driver the surfaces between the cap and handle engage with the ordinary working pressure used in driving the screw. The spring in the handle releases the friction when the pressure is withdrawn on the reverse movement, and the cap returns with the hand without withdrawing the screw. Since the cap always rotates with the hand the latter does not become chafed or blistered.

BENJAMIN FRICTION-DRIVE SCREW-DRIVER.

Hydroelectric Power from the Rhone.

A scheme has been elaborated for using the Upper Rhone for power purposes. A reservoir is to be constructed at Genissiat with a capacity of 11,000 million gallons from which 100,000 horsepower will be obtainable. The current will be transmitted at a pressure of 120,000 volts.

Current Electrical News

COMMISSION NEWS FROM NEW YORK.

(Special Correspondence.)

At the second hearing in its investigation of the surface street-railway transfer question the Public Service Commission, First District, announced that it would adopt an order directing the surface street railway companies in New York City to re-establish transfers at practically all points where they were abandoned. The companies have until August 10 to establish a schedule of transfers, and the commission adjourned its hearings until August 16.

The Long Acre Light & Power Company has asked the Commission for permission to issue bonds to the amount of $10,000,000. The bonds proposed will bear interest at five per cent, and will run for fifty years. The Empire Trust Company, of New York City, is named as trustee under the proposed mortgage. The Commission recently denied the original application to issue stock of $10,000,000 and bonds of $50,000,000.

Plans for the reorganization of the Twenty-eighth and Twenty-ninth Street Crosstown Railroad Company were made public at the Public Service Commission's offices. Details provide for the issuance of capital stock amounting to $500,000, with bonds of $1,000,000, which, together, will equal one-half of the present outstanding capitalization. It is proposed that not less than $751,000 of the new securities shall be sold to the Third Avenue Railway Company, the new company organized to take over the Third Avenue Railroad system which will operate the Crosstown Company. The application was submitted by a committee of bondholders, which consisted of John W. Hamer, Horace A. Doan, A. Merrit Taylor, W. C. Heppenheimer and Charles E. Loxley.

COMMISSION NEWS FROM WASHINGTON.

(Special Correspondence.)

The hearing of the Bell Telephone Company regarding service given in Lewis County, was held by the Public Service Commission on July 20. The complaint sets forth that the Bell Telephone Company refuses to allow the subscribers of an independent company to obtain connection with Winlock, Chehalis or Morton, and as a result the subscribers of the independent line have no long-distance connection whatever.

Commissioner Jesse S. Jones states that this case will bring up squarely before the Commission the question of the rights of the Commission to order physical connections between rival but non-competitive telephone companies. In the complaint lodged by the citizens of Silver Creek, where the independent company is located, it is charged that at one time they were able to secure service with the Bell company at Winlock and Chehalis and that they were able to reach Tacoma by long-distance from Morton, having a connection with the small independent companies, running west from the latter place.

However, the Bell company, it is alleged, has ordered the independent company operating out of Morton to cease doing business with the Silver Creek company, and the company has complied. As a result Silver Creek is now unable to reach Tacoma in that direction, and being cut off at Winlock and Chehalis, the subscribers are unable to reach any outside point with which they do not have direct connection. It is predicted that this case will go direct to the Supreme Court for the reason that it involves the question as to the extent of the powers of the Commission.

LIGHTING AND POWER.

(Special Correspondence.)

SYRACUSE, KANS.—This city is to install a new electric light system. P.

ARLINGTON, S. D.—George Johnson will install an electric light system. C.

GROVE, OKLA.—This city has voted $35,000 in electric light and waterworks bonds. P.

VAN HORNE, IOWA.—The electric light plant was burned with a loss exceeding $14,000.

VALDEZ, ALASKA.—Plans are under way for installing electricity at the Cliff mine near here.

ENTERPRISE, ORE.—The Enterprise Electric Company, has been incorporated for $50,000.

MINNEOTA, MINN.—The installation of an electric light plant to cost $10,000 is being agitated. C.

WAUPUN, WIS.—A campaign has been started for the installation of ornamental curb lights. C.

PLANKINTON, S. D.—W. A. Kurtz, of Wolsey, has applied for an electric light franchise here. P.

FORT MADISON, IOWA.—Business men are planning the installation of four blocks of White Way. C.

JACKSON, CAL.—Articles of incorporation of the Mokelumne River Power Company have been filed.

MINNEAPOLIS, KANS.—This city has voted $15,000 in bonds for an electric light and waterworks plant. P.

VAN HORNE, IOWA.—It is proposed to take a vote on establishing a municipal electric light and power plant. C.

DELAND, ILL.—I. C. Bowsher has been granted a twenty-year franchise to operate an electric light plant. Z.

CLARENDON, TEX.—The Clarendon Light & Power Company has been chartered with a capital stock of $25,000. P.

LIBERTY, TEX.—The Liberty Light & Power Company has purchased the machinery for an electric light plant. P.

LENA, ILL.—The Lena Electric Light & Power Company has increased its capital stock from $12,000 to $20,000. Z.

PALMYRA, ILL.—Henry W. Mandle of Virden, Ill., has purchased the electric light plant here from C. L. Gates. Z.

SPRINGFIELD, MO.—The Federal Light & Traction Company is preparing plans to double the capacity of its plant. P.

BRYAN, TEX.—This city will vote on a bond issue of $20.000, part of which is to go for improving electric light plant. P.

SUMNER, ILL.—A franchise to operate an electric light plant has been granted Edwin A. Dreiman by the City Council. Z.

BELOIT, WIS.—The plant of the North Freedom Electric Light Company has been purchased by O. J. Nelson and A. H. Voeck.

MANDAN, N. D.—The contract for the construction of a power plant to cost $74,000 was let to G. W. Haggart, Fargo, N. D. C.

BROWNS VALLEY, MINN.—A vote will be taken July 25 on issuing bonds for $10,000 for the installation of an electric light plant. C.

MOBRIDGE, S. D.—The Mobridge Electric Light, Power & Heating Company has started the construction of a light and power plant. C.

MORA, MINN.—A franchise has been granted to the Eastern Minnesota Electric Light & Power Company to furnish electric light and power. C.

OROVILLE, CAL.—The Sacramento Valley Power Company is planning an extension of its system to Oroville and other towns in the Sacramento Valley.

LEWISTON, IDA.—An extensive power plant is being built on the North Fork near here and also one at the mouth of Whiskey Creek on Orofino Creek.

PHOENIX, ARIZ.—The United States Reclamation Service has been granted a franchise for a power line through the corporation limits of Tempe, Ariz.

REDDING, CAL.—The Northern California Power Company is extending its lines from this city to Kennett. A new substation will be erected at Kennett. A.

LOS ANGELES, CAL.—An electric lighting system is being installed in Lawndale, the tract recently opened by the Guy M. Rush Company of this place.

CHICO, CAL.—The Great Western Power Company has purchased for $30,000, a large tract of land near here. A large power dam will probably be erected.

ST. NAZIANZ, WIS.—This village, as well as Gato and Whitelaw, will be supplied with electric light and power by the Oslo Dam Electric Light Company. C.

SHEBOYGAN, WIS.—The Sheboygan Railway & Electric Company announces that it proposes to furnish electric light and power to the village of Sheboygan Falls.

PASADENA, CAL.—This city has awarded a contract to the Westinghouse Electric & Manufacturing Company, for one steam-turbine unit for the municipal plant. A.

EASTHAMPTON, MASS.—Construction work on an electric line has been started between here and Southampton and electric service will be supplied in a short time.

LITTLE FALLS, MINN.—The American Engineering & Construction Company, Cleveland, O., has applied for a franchise to install an electric light and power plant. C.

MINNEAPOLIS, MINN.—The City Councils of Minneapolis and St. Paul will promote a corporation to control the power to be furnished by the new federal dam. C.

VANCOUVER, WASH.—The local plant of the Portland Rail-

way, Light & Power Company, which was destroyed by fire some time ago, is being rebuilt at a cost of $65,000.

HACKETTSTOWN, N. J.—Clusters of four incandescent lamps are to be substituted for each of the arc lamps now used in the city. The new installation will total 240 lamps.

SAN FRANCISCO.—The Great Western Power Company has closed a contract with the North Sacramento Land Company to supply current for light and power at North Sacramento, Cal.

ST. PAUL, MINN.—The Consumers' Power Company, controlling the Northern Heating & Electric Company, will expend $10,000,000 in improving its several power plants in the state. C.

SAN FRANCISCO, CAL.—The San Francisco Gas & Electric Company has had plans prepared for a new power plant. Bids will be called for at once. The estimated cost of building is $70,000. A.

VALLEJO, CAL.—The Pacific Portland Cement Company has made application for a franchise for an electric lighting and power line along certain highways of Salano County near Vacaville, Cal.

LOS ANGELES, CAL.—The Pacific Light & Power Company has been granted a franchise for a light and power line from the foothill district east of the city limits of Los Angeles to Pomona.

FRESNO, CAL.—The San Joaquin Light & Power Company has let the contract for construction of a substation near Lemoore, Cal. The company is also building a new substation near the town of Clovis. A.

STRONGHURST, ILL.—M. F. Schierbaum, of Okawville, has purchased the electric lighting plant of Steele Brothers. The new owner will have a ten-year contract for electrically lighting the city streets. Z.

MANCHESTER, CONN.—Cheney Brothers, through their subsidiary company, the South Manchester Light & Power Company, have bought the interests of the Manchester Light & Power Company.

MINNEAPOLIS, MINN.—The Council is considering the question of installing a system of 150 incandescent electric lights, to be operated by power from the garbage crematory, at a cost of $50,000. C.

SAN DIEGO, CAL.—The San Diego Consolidated Gas & Electric Company is spending about $75,000 in laying underground conduits for light, telephone and street railway wires in the streets of this place.

STOCKTON, CAL.—The Santa Fe Railroad will install an electric lighting and power system at Riverbank, Cal., its new terminal, thirty miles from Stockton. New shops of the company will be located at this point.

PORTLAND, ME.—The Consolidated Electric Light & Power Company, of Portland, is building a line from Windham to Dunstan Corner and will furnish the Portland railroad with power, and the village with lights.

PENDLETON, ORE.—A complete power and generating plant will be installed in the new State Insane Hospital to be erected here. Plans have been prepared by the state architect, W. C. Knighton, of Salem. A.

TUCSON, ARIZ.—H. A. Smith of this city will build a large power plant near Noria, Sonora, Mex. The plant will supply power for mine and smelter operation in the district, as well as for lighting the town of Llano. A.

NASHVILLE, TENN.—Ornamental lights are being installed on the main streets here. A committee from the Board of Trade is working out a design for a large illuminated sign to be placed at the railway terminal.

QUINCY, ILL.—Contract for the installation of 118 ornamental lighting standards with five tungsten lamps each has been let by the Chamber of Commerce to the J. W. Turner Construction Company of Des Moines, Iowa. Z.

MONTGOMERY, ALA.—The Industries Light & Power Company, which has a paid in capital of $12,500, has filed its papers of incorporation. The incorporators are Benjamin Russell, J. H. Henderson and O. C. Thomas.

FT. WORTH, TEX.—The electric power plant and its wires, poles and franchise, has been sold to the J. R. Nutt Light & Power Company, a Cleveland syndicate which owns the light plant and other properties here, for $250,000.

TIOGA, TEX.—A proposition to install an electric light plant, which was presented by L. A. Marshall to the Commercial Club was favorably looked upon. It is expected that the plant will be put in operation at an early date.

NIAGARA FALLS, N. Y.—The Frontier Power Transmission Company has been incorporated by Cohn, Chormann & Franchott, attorneys, and others of Niagara Falls to generate electric power. The company is capitalized at $100,000.

NEWBURG, MO.—An ordinance has been passed by the Board of Aldermen granting W. N. Schwaebe and E. Spralding the right to maintain and operate an electric-light system in this city. The franchise given is for a term of twenty years.

NEW CUMBERLAND, O.—The Hancock Electric Company has been organized to construct and operate a power plant. The capital stock is $12,000 and the incorporators are John F. Flood, Harry E. Armstrong, Nelson D. Miller, Samuel E. McCoy, Samuel G. Stewart, of Steubenville, O.

McPHERSON, KANS.—The plant of the McPherson Light Company has been completed, and the transmission of power to other towns is being considered. Canton, Galva, and Hillsboro are taking steps to secure electric power from the plant.

RICHMOND, VA.—A charter has been issued to the Danville Traction & Power Company of Danville, with a capital of $200,000 to $300,000. The company is empowered to operate a street railway and power company in Danville.

ALTON, ILL.—The mayor has appointed a committee consisting of J. P. Callagahan, Peter Guertler, F. E. Johnson and Orland Hemphill to devise ways and means for furnishing the city with a municipal lighting plant before November 12, 1912. Z.

HARDWICK, VT.—A resolution has been passed by the village authorizing an expenditure of $65,000 for the purpose of installing new machinery at the village electric light and power plant and the building of a water-storage reservoir.

PORTLAND, ORE.—The Portland Railway Light & Power Company has asked permission to construct a high-tension power line across the Willamette River from the foot of Linn Avenue, Sellwood to a point south of Riverview Cemetery.

EAST CHICAGO, IND.—The merchants of the cities of East Chicago & Indiana Harbor contemplate installing a street-lighting system in the two cities. Literature on the subject is requested by the Civic and Industrial Committee of the Commercial Club.

ASHTON, ILL.—A twenty-five-year franchise to operate an electric light plant has been granted the Oregon Light & Power Company. A transmission line from Brown's Corners, branching from the line between Oregon and Franklin Grove will be built. Z.

BLOOMINGTON, ILL.—Because of the demand for increased installation of ornamental lights Seth S. Noble, superintendent of water and light has recommended to the City Council the purchase of additional machinery for the municipal lighting plant. Z.

KINGMAN, ARIZ.—J. H. Hays and Robert S. Waters will install a hydroelectric plant on Trout Creek in the eastern part of Mohave County, Ariz. The power will be transmitted to mining districts in that section and used to operate machinery of the mills. D.

BISBEE, ARIZ.—The holdings of the Bisbee Light & Power Company of Bisbee, Ariz., were recently sold at foreclosure to satisfy a mortgage held by the Los Angeles Trust Company of Los Angeles, Cal. The purchaser was W. J. Ainsworth of West Union, Iowa, and the consideration was $30,000. D.

PARRAL, N. M.—Work on the Conchos dam near the town of Santa Rosalia is being pushed, and it is expected that it will be finished before another year. The electric lighting men and the mining men of this district are considering a proposition to obtain power from the Conches River Irrigation project.

ABERDEEN, WASH.—After an outlay of nearly $75,000, power station No. 2, to be run in connection with the Grays Harbor Power & Lighting station No. 1, is ready for operation. The new station will connect with the dredger of the Tacoma company, which has the contract to fill the tidelands in the western part of the city.

LOS ANGELES, CAL.—The Mount Shasta Power Company has commenced construction of a seven-mile power tunnel from Big Bend, on the Pitt River, to the other side of the hills, where a power plant will be installed to be operated by this flow. The tunnel will be nineteen feet high and twelve feet wide, and will be the longest for such service in California. A.

FRESNO, CAL.—The current will be turned on in the Bakersfield main line of the San Joaquin Light & Power Company in a short time. This will supply the West Side oil fields and many other places in the lower end of the San Joaquin Valley. The substation at McKittrick is almost completed and this town and the town of Reward are being wired.

SUTTER CREEK, CAL.—A new power line from Electra to Sutter Creek, a distance of twelve miles, is now in course of construction by the Pacific Gas & Electric Company, the change being caused by the greatly increased amount of power being used at the mines along the Lodge. It is estimated that the improvement will involve an expenditure of about $25,000.

McLEAN, ILL.—J. H. Baker of McLean and B. F. Baker of Le Roy have purchased the property of the Palmer-Darnall Electric Company, the headquarters of which are at McLean. The company operates exchanges at Atlanta, McLean and Armington, and owns a number of rural lines. The lines at Atlanta will be rebuilt and an attempt made at consolidation of the lines there. Z.

NEWARK, N. J.—The contract for the installation of an electric light and power plant in the department store of the W. V. Snyder Company has been awarded to George W. Fowler & Company, a New York firm. Work will be commenced at once and it is expected that the plant will be completed by October. The plant will be used for heat and power as well as lighting.

BISHOP, CAL.—The California-Nevada Power Company, of Goldfield, Nev., will construct a power line from Bishop, Cal., to San Bernardino, a distance of 240 miles. Surveys are now being made. The company has applied for franchises in San Bernardino and Riverside Counties, and plans to install power plants and sys-

tem to the extent of $300,000. Delos A. Chappell is president of the company. A.

RIDDLESBURY, PA.—The Colonial Iron Company has placed an order with the General Electric Company for a centrifgul air compressor having a capacity of 20,500 cubic feet per minute at a pressure of thirteen to twenty-five pounds. This compressor will be equipped with a constant-volume governor driven by a Curtis steam turbine of the condensing type. It is designed for use in connection with a blast furnace at the company's plant here.

PASADENA, CAL.—This city will install a fiber-conduit system for the electric lighting companies and a vitrified conduit for the telephone system. These will be the property of the city, the companies paying a rental. The estimated cost is $45,000. The work has been started. The city will install new bronze electrolier lighting fixtures, each bearing eighty-candlepower incandescent lights and spaced 100 feet apart. The estimated cost is $30,000. A.

EUFAULA, ALA.—The City Council of Eufaula has decided to invest the sum of $50,000 in the erection of a municipal lighting plant. The location of the plant has not yet been determined upon, though the plant will either be located on the site occupied by the lately burned plant or in close proximity to the water works. The work on the new plant will begin within the near future, and will be completed as early as possible. In the meantime, a temporary dynamo has been installed. I.

TIFFIN, O.—The Tiffin Electric Company, which controlled the power and electric light plants in this city, has been absorbed by the Ohio Light & Power Company, the new concern organized by the syndicate owning the Tiffin and several other plants. The consolidation was made for the purpose of uniting the properties so that an issue of $1,500,000 worth of bonds could be secured. The mortgage covering this same has been placed in the hands of the Knickerbocker Trust Company of New York.

LOCKPORT, N. Y.—The Frontier Power Transmission Company, which is capitalized at $100,000, has been incorporated by James S. Simmons, William P. Baker and Christian U. Widmer, all of Niagara Falls. The objects of the company are the manufacture and distribution of electricity for both heat and power in Buffalo, Tonawanda and the town of Tonawanda, Erie County, and the cities of Niagara Falls, North Tonawanda, the village of LaSalle and the town of Wheatfield, Niagara County.

WHITMIRE, S. C.—The Glenn-Lowery Manufacturing Company will abandon steam power and install an equipment of machinery for driving its plant by electricity. It has closed a contract for the electricity to be furnished by the Whitmire transmission lines of the Southern Power Company, whose main offices are at Charlotte, N. C. The Glenn-Lowery mill operates 36,000 ring spindles, 775 broad looms, 125 narrow looms and accompanying equipment, on the production of print cloth. It has 450 operatives and will require 1,500 horsepower under the new arrangement.

RED ROCK, N. M.—The installation of a large hydroelectric plant on tne Gila River near Red Rock is contemplated by Col. J. W. Carter, of Silver City, and associates. Engineers are making preliminary surveys with a view of locating a site for the proposed plant. Transmission lines will be built from the power station to the Mogollon mining district for supplying the energy for operating the machinery of the mines and mills. Other transmission lines will also be constructed to Silver City and a number of towns and industrial centers within a radius of about 100 miles of Red Rock. D.

EUGENE, ORE.—The work of constructing the $200,000 hydroelectric plant on the McKenzie River has been completed after three years of work. The power plant, which is sixteen miles from Eugene, takes its water from the McKenzie through a ditch four miles long, and generates 2,400 horsepower. The machinery consists of two 1,200-horsepower Pelton turbines and two generators. There are two substations and a transmission line which crosses both the McKenzie and the Willamette River. The generators operate at 2,300 volts which is stepped up to 22,000 for transmission. The plant is municipally owned and operated.

TOLEDO, O.—James Ashley, of Toledo, representing eastern capital, has applied to the State Board of Public Works at Columbus for a twenty-five-year contract for the use of the waste or surplus water of the Laramie and Grand reservoirs to be impounded and used for generation of power to be used in furnishing current for a large beet sugar plant at Defiance, O., and for other purposes. The lessees agree to put the state to no expense in getting the water and will pay $4,000 a year rental. The same capitalists are interested in the new Toledo power plant. It is the intention to erect power plants at each reservoir. H.

JOHNSTOWN, PA.—Charters have been procured and surveys made for the extension into Cambria County of the service lines of the large electric power plant located on the Juniata River, near Warriors' Ridge, Huntingdon County. The Juniata Hydro-Electric Company's plant is now supplying current in Altoona and at several points west of that city. The intention of the management of the central station is to offer current to the mining operations along the Pennsylvania Railroad. The present plans contemplate a service reaching to the mines at Nant-y-Glo, Twin Rocks, Vintondale, and Wehrum, on the Blacklick Branch of the Pennsylvania.

ELECTRIC RAILWAYS.

(Special Correspondence.)

BRANDON, MAN.—J. D. McGregor has applied for a franchise for a street railway. C.

ROCHELLE, ILL.—The Amboy & Lee Center Electric Railway contemplates extending its line to Rochelle. Z.

DULUTH, MINN.—The Council has passed an ordinance granting a franchise to the Suburban Traction Company. C.

IOWA CITY, IOWA.—The Iowa City Electric Railway Company will shortly commence the construction of another line. C.

RED OAK, IOWA.—Work is about to be commenced on the construction of an interruban line to Imogene to connect with the Wabash. C.

CHICO, CAL.—The Northern Electric Railway Company has made application for a franchise for an electric railway along the streets of this town.

MANKATO, MINN.—J. J. Cummings, Chicago, has acquired control of the Mankato Electric Traction Company and will install many improvements. C.

SAN BERNARDINO, CAL.—The right of way for an electric railroad from Urbita Springs to Colton is being secured and construction will begin at once.

PASADENA, CAL.—The work of electrifying the Southern Pacific line in this city, from the Colorado Street Station, Broadway, to Bellevue drive, is well under way.

WOODLAND, CAL.—T. T. C. Gregory, president of the Vallejo & Northern Railroad Company, states that construction on the road will begin in a short time. A franchise has been granted.

SACRAMENTO, CAL.—The Sacramento Electric, Gas & Railway Company is preparing to extend its street railway system through the suburbs to the east and southwest of the city.

LEXINGTON, KY.—The Kentucky Traction & Terminal Company has been incorporated with a capital of $2,500,000 by John Blair McAfee, Richard C. Stoll, J. M. Skaim, P. M. Chandler, J. W. Stoll and T. D. Murray.

LIMA, O.—It is thought that the limited service between Lima and Cleveland will be started by August 1, via Western Ohio and allied traction lines. This service will give the first through trains between Lima and Cleveland. H.

PORTERVILLE, CAL.—As soon as the main power plant of the Tulare County Power Company is completed the construction of an electric railroad connecting Porterville, Lindsay and Tulare will be begun. Rights of way have already been secured.

BURLINGAME, CAL.—A resolution has been passed by the Council, granting to the highest bidder a franchise for an electric line, to run from the Southern Pacific Station at Easton through the Easton additions into the foothill country at Burlingame.

KEOKUK, IOWA.—The Interurban Railway Company is planning the construction of an interurban railway between Keokuk, Quincy, Fort Madison, Warsaw, Hamilton, Carthage, Nauvoo, Niota and other towns in western Illinois. The estimated cost is $1,500,000. C.

CHARLOTTE, N. C.—Work on the Chatham car line, which is being constructed by the Charlotte Rapid Transit Company, of which P. Chatham is president, is being pushed rapidly. Already the grading has been completed from the Country Club to the Seaboard Air Line tracks near the Monroe road.

SACRAMENTO, CAL.—Funds have been subscribed to the extent of $20,000 by Yolo, Colusa, Glenn and Tehama Counties for the survey of the proposed road of the Sacramento Valley West Side Electric Railway, recently organized, from Woodland to Kennett, Cal. C. L. Donohue, of Willows, is president of this company. A.

DECATUR, ALA.—Citizens of Valhermoosa and Lacy Springs neighborhoods, in the eastern part of Morgan County, this state, are urging the building of an electric railway to that section from Decatur. The distance is about thirty miles, and it is understood that such an enterprise would receive many donations in the way of rights of way, etc. I.

JACKSON, GA.—Rails for the interurban line which Captain W. F. Smith proposes to build from Indian Springs to Jackson, with branch lines to Griffin, to connect with the interurban line from Atlanta to Macon, are being hauled, and it is announced that the work on the line will begin within a short time. Practically all of the right of way for the line has been secured. I.

SCOTTSBURG, IND.—John E. Greeley, recently appointed receiver for the Indianapolis & Louisville Traction Company, has filed in the federal court a complete inventory of all the company's property. It is stated that a new company is being organized to take over the property and operate the lines. The company operates forty miles of track between Scottsburg and Seymour. S.

QUINCY, ILL.—Promoters of the Quincy & Western Illinois Electric Company at a meeting at Keokuk, Iowa, decided to incorporate with capital of $5,000 for the purpose of building an electric interurban railway between Quincy and Niota, Ill., with branches to Keokuk, Iowa, Warsaw, Nauvoo and Carthage. Henry Dayton of Quincy was elected president of the organization. Surveys will begin at once. Z.

HENDERSON, KY.—The survey of the proposed net work of traction lines out of tnis city to western Kentucky has been completed and the estimated cost placed at $3,000,000. Two-thirds of the right-of-way has been secured and the work of financing the enterprise is proceeding rapidly. The terminals of the three lines will be Uniontown, Providence and Owensboro. H. U. Wallace is chief engineer. S.

HALIFAX, N. S.—A survey is being made of the proposed electric road from Lunenburg to Riverport, Nova Scotia. Upon completion of the survey the county authorities will take action, and, if satisfactory, will provide the part of the cost to be borne by the county. The road will be twelve miles in length, with a spur extending to Park Creek. The cars will probably be run by a storage battery. The road will be owned and operated by a private company. T. G. Nichol, of Mahone Bay, Nova Scotia, is the promoter.

HILLSBORO, TEX.—The citizens of Hillsboro and adjacent territory have accepted a proposition offered by the Southern Traction Company to construct an interurban electric railway through here, the proposed line to run from Dallas to Waco. The proposition provides that preferred stock of the company to the amount of $75,000 shall be subscribed and the right of way from a point in the northwestern portion of Hill County through tne county to a point south of Abbott, including a franchise through the town of Hillsboro be donated. J. F. Strickland, of Dallas, is president.

TERRE HAUTE, IND.—The Terre Haute, Indianapolis & Eastern Traction Company has placed an order with the General Electric Company for two 300-kilowatt rotary converters, fifteen 100-kilovolt-ampere transformers and a switchboard. The rotary converters and six of the transformers will be installed in the Maywood substation. Six of the transformers will be installed in the Mooresville substation and three in the Martinsville substation. The transformers are oil-cooled, twenty-five-cycle units, 33,000 volts primary and 390 volts secondary and are provided with fifty per cent starting taps on the secondary.

TELEPHONE AND TELEGRAPH.

(Special Correspondence.)

MT. ETNA, IND.—The Majenica Telephone Company has obtained a franchise to operate here.

JONESBORO, LA.—The Southern Telephone Company is about to reconstruct its telephone system.

BERRIEN SPRINGS, MICH.—The Berrien Springs Telephone Company has been incorporated with a capital of $10,000.

EMERY, TEX.—The Rains County Rural Telephone Company has been chartered with a capital of $2,000.

ALVA, OKLA.—The North Eaglechief Valley Telephone Company has just been incorporated by John F. Parsons and others.

GRINNEL, IOWA.—The Interior Telephone Company is planning the erection of a fireproof building, equipped with the latest improvements. C.

CENTRALIA, WASH—The Hanaford Skookum Telephone Company has been incorporated with a capital of $1,500 by A. N. Bannse and W. L. Eshom.

NAPOLEON, O.—The Napoleon Home Telephone Company's plant has been sold to W. L. Parmenter of Lima, O. The purchase price was $21,100.

EMORY, TEX.—The Rains County Rural Telephone Company was incorporated with a capital of $2,000. The incorporators are B. F. Pippin, J. A. Amis and B. A. Carter.

OAKESDALE, WASH.—The Oakesdale Home Telephone Company was recently incorporated with a capital of $10,000 by A. G. Woodward, Edward Roberts and J. W. Martin.

RED GRANITE, WIS.—The Red Granite Telephone Company has been incorporated with a capital of $4,000. The incorporators are Louis Lueck, F. W. Carley and William Bannermann.

ASTORIA, ORE.—The Nehalem Valley Telephone Company has been incorporated with a capital of $2,500, to construct a system from this city to Elsie, Ore. James Jamison and J. C. Pope are the incorporators.

ALPINE, TEX.—W. Durritt, of San Marcos, Tex., has purchased the local and long distance exchange and equipment of the Alpine Telephone Company, the purchase price being $18,000, with an additional $1,000 for equipment in transit. The former owners were J. E. Mills & Sons. D.

BRENHAM, TEX.—A new telephone line is to be erected between Welcome and Bliebersville, and Brenham, a distance of fifteen miles. Officers of the constructing company are as follows: C. Hohlt, president; H. W. Hohlt, vice-president; C. Luedeker, secretary; H. Krueger, treasurer; H. Wittenben, pubchasing agent.

AUSTIN, TEX.—It is announced by J. L. Hudson, of the Martin Telephone Company, that the telephone line being run into Austin via Round Mountain will be completed and put into operation by September 1. The Independent Telephone Company of this city will handle the Austin end of the line for long distance service. The Martin Telephone Company is arranging to furnish its customers interested in the cotton business with full daily reports of the cotton crop in its territory. D.

ELECTRICAL SECURITIES.

Business as reflected in steel and copper reports is holding up well for this midsummer period. The tonnage of unfilled orders on the books of the United States Steel Corporation on July 1 showed an increase of 247,871 tons. The monthly report of the Copper Producers' Association showed a decrease of 8,000,000 pounds in stocks of refined metal on hand on July 1, due to increased exports. A new record has been set in the sale of wire, and much structural steel is being ordered for railroad bridges.

The Denver Gas & Electric Light Company, a merger of the Denver Gas & Electric, Lacombe Electric, and Denver Steam Heating companies, has authorized an issue of $25,000,000 five-per-cent bonds, of which $8,000,000 are reserved to redeem bonds of the subsidiary concerns when due.

The gross earnings of the Boston & Worcester Street Railway Company for June were $57,220, a gain of 5.6 per cent over June of last year. The gross earnings for the full fiscal year ended June 30, were $615,451, a gain of $45,315, or about 8 per cent over the gross earnings for the twelve months ending June 30, 1910.

DIVIDENDS.

American District Telegraph Company of New Jersey; regular quarterly dividend of one per cent, payable July 28 to stock of record July 18.

American Light & Traction Company; regular quarterly dividends of two and one-half per cent in common stock and two and one-half per cent in cash on the common stock and one and one-half per cent on the preferred stock, payable August 1 to stock of record July 17.

Binghamton Light, Heat & Power Company; regular quarterly dividends of one and one-half per cent on the preferred stock and three-quarters of one per cent on the common stock, payable July 15 to stock of record June 30.

Commonwealth Edison Company; regular quarterly dividend of one and three-quarters per cent, payable August 1 to stock of record July 15.

Electric Company of America; regular semiannual dividend of three and one-half per cent, payable August 3 to stock of record July 22.

Electric Bond & Share Company; regular quarterly dividends of one and three-quarters per cent on the preferred and two per cent on the common stocks; the preferred dividend payable August 1 to stock of record July 20; the common dividend payable July 15 to stock of record July 13.

J. G. White & Company, incorporated; regular quarterly dividend of one and one-half per cent on the preferred stock, payable August 1 to stockholders of record July 20.

CLOSING BID PRICES FOR ELECTRICAL SECURITIES ON THE LEADING EXCHANGES AS COMPARED WITH THE PREVIOUS WEEK.

NEW YORK.

	July 17.	July 10.
Allis-Chalmers common	8	8
Allis-Chalmers preferred	28¼	28¼
Amalgamated Copper	68¾	69½
American Tel. & Cable	*78	*78
American Tel. & Tel.	138	138¼
Brooklyn Rapid Transit	83⅛	82¼
General Electric	161¾	163
Interborough-Metropolitan common	18	17½
Interborough-Metropolitan preferred	52¼	50
Kings County Electric	129	129
Mackay Companies (Postal Telegraph and Cables) common	87½	88½
Mackay Companies (Postal Telegraph and Cables) preferred	74¼	73½
Manhattan Elevated	135	135
Metropolitan Street Railway	*18	*18
New York & New Jersey Telephone	103	103
Pacific Tel. & Tel.	46½	47½
U. S. Steel common	78⅞	78¾
U. S. Steel preferred	118¼	118
Western Union	81⅝	79½
Westinghouse common	75⅛	76¼
Westinghouse preferred	*111	*111

*Last price quoted.

BOSTON.

	July 17.	July 10.
American Tel. & Tel.	138	138¼
Edison Elec. Illuminating	281	281
General Electric	161½	160
Massachusetts Electric common	23½	22½
Massachusetts Electric preferred	94¾	93¾
New England Telephone	145	145½
Western Tel. & Tel. common	20	18
Western Tel. & Tel. preferred	95	96½

PHILADELPHIA.

	July 17.	July 10.
American Railways	43¾	43¾
Electric Company of America	12⅛	12⅛
Electric Storage Battery common	54	54½
Electric Storage Battery preferred	54	54½
Philadelphia Electric	17⅞	17¾
Philadelphia Rapid Transit	22¼	20⅜
Philadelphia Traction	87½	84
Union Traction	52	49½

CHICAGO.

	July 17.	July 10.
Chicago Railways, Series 1	87½	87½
Chicago Railways, Series 2	27¾	25½
Chicago Subway	3⅜	3⅞
Chicago Telephone	122	120½
Commonwealth Edison	137¼	134½
Metropolitan Elevated common	27	27
Metropolitan Elevated preferred	74½	74½
National Carbon common	112	112
National Carbon perferred	118	118

PERSONAL MENTION.

J. B. BUNDY, of Carbondale, O., has been appointed chief auditor of the Ohio & Mississippi Valley Telephone Company, succeeding A. A. Wicks, resigned.

JAMES H. WISE, hydraulic engineer with F. G. Baum & Company, of San Francisco, Cal., has been appointed assistant general manager of the Pacific Gas & Electric Company.

GEORGE M. BENNETT has resigned his position as president of the Urbana, Ill., Commercial Club to devote his entire time to his duties as president of the Kankakee-Urbana Traction Company.

CLARENCE MACKAY, president of the Commercial Cable Company, sailed for Europe, on July 11, on board the *Kaiser Wilhelm II.* While abroad he will inspect the European stations of the company.

S. L. NAPTHALY, chief engineer and general manager of the Central California Traction Company, has resigned to take charge of the plants of the Great Western Power Company in California. He will be succeeded by Harry A. Mitchell, formerly secretary, with offices at San Francisco, Cal.

CHARLES RUFFNER, formerly of Palmyra, Mo., who has been in charge of the Utah district of the Telluride Power Company, has been appointed engineer for the North American Company, with headquarters in St. Louis, to direct the building of the power transmission line from Keokuk, Iowa, to St. Louis.

W. L. Arnold, of the Arnold Company, which owns the Elgin-Belvidere Electric Railroad, has resigned his position as general manager of the road, effective August 1. He will be succeeded by E. E. Downs of Chicago, who will combine the duties of superintendent and general manager, also succeeding W. A. Russell, resigned.

JAMES D. MORTIMER, general manager of the Milwaukee Electric Railway & Light Company, has been elected vice-president of the Union Electric Light & Power Company, of St. Louis, succeeding James Campbell, president of the North American and Milwaukee Companies. It is rumored that Mr. Mortimer will permanently succeed President Alten S. Miller of the St. Louis corporation.

PHILLIP E. SCHILLING, who for several years has been connected with the accounting department of the Toledo Railways & Light Company, has been promoted to chief clerk of the department, taking the place of A. J. Lamb, who recently died. Mr. Schilling was in the employ of the old Toledo Gas, Electric & Heating Company previous to its absorption by the Toledo Railways & Light Company in 1907.

MASON B. STARRING, president of the Northwestern Elevated Railway Company, has been elected president of the Chicago & Oak Park Electric Railway Company, succeeding the late Clarence B. Knight. Mr. Starring was formerly general manager of the Chicago City Railway Company, and left that corporation to go with the Northwestern Elevated. He is more or less in touch with the plans for the merger of the surface railway and elevated roads, concerning which there has been so much publicity lately, and his selection as head of the Chicago & Oak Park system unifies the two managements so that the details of the two roads as related to the merger may be worked out very satisfactorily.

ALONZO PAWLING, president and treasurer of the Pawling & Harnischfeger Company, Milwaukee, Wis., and for many years a prominent figure in the machinery field, has disposed of his interests in the company and retired from business life. Mr. Pawling's withdrawal from the business world will mean a distinct loss to the many friends he has made during his long and successful career as one of the foremost manufacturers of the middle west. The Pawling & Harnischfeger Company was founded by Mr. Pawling and Henry Harnischfeger in December, 1884. From a small beginning the concern has grown to huge proportions. Henry Harnishchfeger becomes president and treasurer of the company; W. H. Hassenplug, vice-president; F. P. Breck, second vice-president, and S. H. Squier, secretary. There will be no changes in the policy of the company or in its organization other than that given above.

PROPOSALS.

ENGINE-GENERATOR SETS.—The Board of Supervisors at Los Angeles, Cal., will receive bids until August 31 for furnishing and installing two engine-generator sets in the Hall of Records. Plans and specifications may be obtained from the office of Hudson & Munsell, Los Angeles. A.

WIRING.—The office of the Supervising Architect, Washington, D. C., will receive sealed bids for doing electrical work in connection with the construction and remodeling of post offices in the following places; bids closing on the dates given below:

Work.	Place.	Date.
Wiring, conduits and fixtures	Rock Springs, Wyo.	July 28
Wiring, conduits and fixtures	Huron, S. D.	August 1
Wiring, conduits and fixtures	Great Bend, Kan.	August 2
Wiring and conduits	Juneau, Alaska	August 8
Wiring, conduits and fixtures	Lebanon, Ky.	August 10
Wiring and conduits	Richford, Vt.	August 14
Wiring, conduits and fixtures	Massillon, O.	August 16

Drawings and specifications may be obtained from the custodian at the post-office site or at the office of the Supervising Architect.

LEGAL NOTES.

CONTRACTS FOR EXCHANGE OF TRAFFIC BETWEEN TELEPHONE COMPANIES.—In a suit by the Home Telephone Company to enforce a contract made with the Sarcoxie Light & Telephone Company, the Supreme Court of Missouri has decided that a contract for exclusive exchange of traffic between points reached by the lines of the respective companies is not in violation of the statutes or public policy, since the contracting parties were not competing companies. The case was dismissed by the lower court but has now been remanded for trial. The Sarcoxie Company was, after the agreement, absorbed by the Missouri & Kansas Telephone Company, and proceeded to divert all of its traffic to the lines of that company. The Home Telephone Company asks for 10,000 damages and an injunction restraining the defendant from breach of contract.

TAXING FRANCHISES OF PUBLIC-SERVICE CORPORATIONS IN CALIFORNIA.—By a decision of the California State Supreme Court, an important precedent is set in granting an individual county the right and authority, under law, to tax public-service franchises granted by the state. This decision has resulted from the taxing, by Los Angeles County, of the franchises given to the Western Union and Postal Telegraph Companies. An assessment was levied by County Assessor Hopkins against the former corporation for the year ending June 30, 1908, for $50,000 on its "franchise granted by the State of California to use the public highways of the City of Los Angeles," the rate applicable to the property making a tax of $520. Upon the failure of the company to liquidate the assessment, legal means were taken to compel payment; accordingly the Western Union Company brought action to enjoin the assessor from selling its property to satisfy the tax, based on the ground that the assessment and tax were void. This claim was sustained by the Superior Court. Upon the appeal of the county, the Supreme Court in June reversed the decision of the lower court, and held that the act of July 24, 1866, conferred the privilege to construct, maintain and operate lines of telegraph over such roads as are public highways, but that the company is subject to the right of the state to charge and receive compensation. As a basis for the decision the opinion says: "It follows that the plaintiff's exclusive occupation of portions of the streets of the city of Los Angeles without liability for compensation, to the extent at least to which its system was constructed therein at the time of the adoption of section 536, civil code, and its right to such occupation free of charge by the city, are based solely on the last named section, and that as to such occupation and right this section constitutes a grant in the nature of a franchise accepted by it, constituting property within this state and assessable in the county of Los Angeles. The claim of the plaintiff that taxation of this franchise is in any way taxation of its federal franchise is utterly without basis. The tax is solely on valuable property within this state—the right to the permanent and exclusive use of portions of the public streets of Los Angeles, free of compensation—a tax differing in no material way from one levied on its poles and wires located within such city. No other point is made against the validity of the assessment here involved."

INDUSTRIAL ITEMS.

THE BOSTON INCANDESCENT LAMP COMPANY, Danvers, Mass., is distributing a booklet exploiting "New England quality" goods.

THE F. W. WAKEFIELD BRASS COMPANY, Vermilion, O., catalogs its standard universal lighting fixtures in a recent publication. A large number of illustrations show the possibilities of the interchangeable Wakefield fixtures.

H. TINSLEY & COMPANY, South Norwood, London, England, have issued bulletins on the Drysdale-Tinsley galvanometer, Dr. C. V. Drysdale's non-inductive low-resistance standard shunts, the Weston normal cells and other pieces of laboratory apparatus.

THE COLUMBIA INCANDESCENT LAMP COMPANY, Cleveland, O., which has for the past nine years maintained sales offices at 2115-2117-2119 Locust Street, St. Louis, Mo., announces that these offices will, on September 1, be moved to the Equitable Building at Sixth and Locust Streets.

THE METROPOLITAN ELECTRICAL SUPPLY COMPANY, Chicago, Ill., announces that it has taken the agency for the Everson Manufacturing Company's vacuum-cleaning machines. Demonstrations of this machine are being made at the main store, 180 West Lake Street, and the branch store, 62 East Jackson Boulevard.

THE CHICAGO FUSE MANUFACTURING COMPANY, Chicago, Ill., has distributed a new circular on enclosed fuses and cutouts, a circular on conduit boxes and covers, and also a set of loose-leaf sheets. The different lines of goods manufactured by the company are shown in a very concise manner, and several new boxes just placed on the market are illustrated.

THE BRIDGEPORT BRASS COMPANY, Bridgeport, Conn., proposes, in a recent folder, that railway companies install a section of "Phono-Electric" trolley wire in the hardest spot in their lines and carefully compare the wear on it with that of other sections. The folder, which is attractively prepared, shows at each corner a piece of wire tied in a knot, indicative of its great flexibility.

THE ELECTRIC CONTROLLER & MANUFACTURING COM-

PANY follows the continuation of its series of articles on automatic magnetic control in the July number of *Common Sense*. Announcement is made by the company of the completion of a new shop, which will so add to the facilities of the factory as to permit much quicker deliveries than were formerly possible.

THE HAZARD MANUFACTURING COMPANY, Wilkes-Barre, Pa., is distributing among the trade a booklet describing its principal insulated-wire products. The high quality of the company's product is emphasized, and mention is made of the Penn New Code wire which was placed on the market May 1, 1911, to meet the new National Electrical Code rules. The main points of these new rules are given in the booklet.

A. G. McCLURE, 228 East Two Hundred and Second Street, New York, N. Y., has prepared for distribution to manufacturers of lamp posts, globes, fixtures, conduit and cable, a circular for utilization in campaigns directed against central station and the boards of trade of municipalities in favor of a tungsten cluster ornamental street-lighting system. Those interested in this matter may secure full information by application to Mr. McClure.

THE AMERICAN SHIP WINDLASS COMPANY reports two notable orders just received for Taylor stokers. The first is for twelve stokers for the New York Edison Company, making a total installation in the Waterside Station of Taylor stokers for 52,650 horsepower of boilers. The second is for five Taylor stokers for the United States Naval Gun Factory at Washington, D. C. These stokers are to be used under 300-horsepower Babcock & Wilcox boilers.

THE LORD ELECTRIC COMPANY, New York, N. Y., recently moved from No. 213 West Fortieth Street to its new offices at No. 105 West Fortieth Street, giving the entire building, of which it formerly occupied a part, to the Lord Manufacturing Company. This move was necessitated by the rapid growth of the Lord Manufacturing Company and its increasing demands for space. The Lord Manufacturing Company will occupy its present quarters until its new factory is completed next spring.

THE KELMAN ELECTRIC & MANUFACTURING COMPANY, Los Angeles, Cal., calls attention in a recent publication to the satisfactory service which the Kelman high-voltage oil switches and circuit breakers have given since their inception eight years ago. Hand-operated, air or hydraulic and electrically operated units are illustrated and described. The Kelman switching mechanism makes use of a pantograph arrangement, providing for two horizontal breaks deep down in the oil.

THE TOLEDO ELECTRIC WELDER COMPANY, Cincinnati, O., describes the process of spot welding in its May bulletin. In this device current at a low voltage passes through water-cooled copper contacts and through the parts to be welded. When the desired heat is obtained the parts are forced together by a hand or foot lever, making an extremely strong spot weld. Several illustrations show test pieces which were, on the application of the external force, torn apart outside the welded spots.

THE KINETIC ENGINERING COMPANY, Philadelphia, Pa., has reproduced in the shape of an advertising folder, a number of letters of recommendation regarding the Kinetic organ blower, used as a source of air-pressure supply in connection with pipe-organs. In order that the requirements of a large organ, and the methods by which the requirements are met, may be thoroughly understood these points have been explained fully in the folder. Some of the points of superiority of the blower as taken up, are its extremely quiet running and the ease of installation.

ARTHUR D. LITTLE, INC., Boston, Mass., has been selected to organize and direct an engineering department for the General Motors Company, of Detroit, Mich. D. T. Randall, the resident director, has been connected with the former organization for some years, and has had extended experience in engineering problems as well as in the equipment and direction of several testing laboratories. Mr. Randall was formerly professor of mechanical engineering at the University of Illinois, and later was in charge of the fuel investigations and producer and gas-engine tests carried on by the United States Government.

THE BRISTOL COMPANY, Waterbury, Conn., describes the Bristol recording water-level gauges in its bulletin No. 142, which was recently distributed. These instruments are used for automatically and continuously recording the depth of water or other liquids in tanks, reservoirs, rivers or canals, and also the depth and rate of flow of water over wiers, and the volumes of liquids in tanks These instruments have an advantage over the float-type instrument as, owing to the use of air to transmit pressure to the recording medium, there is nothing to freeze. A number of sample scales are illustrated in the publication and several novel instances of the use of the recording instruments are cited.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., has received an order from the Houston Lighting & Power Company, Houston, Texas, for a thirty-seven-panel switchboard. This switchboard will control one 3,000-kilowatt, one 2,500-kilowatt, one 1,500-kilowatt and two 600-kilowatt generators, all 2,300-volt, sixty-cycle, three-phase machines. The switchboard will consist of five generator, one blank-generator, four exciter, four station-auxiliary, two alternating-current rotary-converter, two direct-current rotary converter, one synchronous motor, one direct-current generator, five direct-current feeder, eight alternating-current feeder panels, and four blank panels for future circuits. All the alternating-current panels are equipped with remote-control oil-break switches.

THE WAGNER ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., announces the formation of the Wagner Electric Manufacturing Company, Limited, of Canada, with a capital stock of $50,000 fully paid. The Canadian corporation becomes the exclusive Canadian licensee under patents owned and controlled by the St. Louis company, which has granted exclusive manufacturing and sales rights for the full output of the St. Louis company. Alfred Collyer, who for many years, as representative of Wagner interests in Canada is largely responsible for the volume of Wagner business there, has been appointed manager of sales of the new company. The officers of the new company besides Mr. Collyer, are S. M. Dodd, president; W. A. Layman, vice-president and general manager; W. S. Thomas, treasurer. The previous headquarters of the Wagner Electric Manufacturing Company in the Bell Telephone Building, Montreal, becomes the headquarters of the new company.

THE UNITED STATES ELECTRIC COMPANY, New York, N. Y., has, in its bulletin No. 502, published a number of rules which may be applied to railways making use of the telephone in train-dispatching. In this set of eight rules especial stress is laid on the necessity of using the telephone for train dispatching only, and only by an employee on duty. Utmost care should be exercised, and it is of prime importance that the safe course should always be taken. Especial care should be exercised in the transmission of numbers, and any word about which there is the slightest doubt should be spelled out. On calling, according to these rules, the operator's presence should be announced by the word "Dispatcher," giving the name of the station. The answering dispatcher will acknowledge by saying "Right" or "Cut Out." The booklet, in addition to the rules, includes instructions for the use and care of telephone apparatus; all rules and instructions being printed on one side of the page only, for convenience in posting on a bulletin board.

DATES AHEAD.

Ohio Electric Light Association. Annual convention. Cedar Point, O., July 25-28.

Indiana Electric Light Association. Annual convention, South Bend, Ind., August 23 and 24.

International Association of Municipal Electricians. Annual convention, St. Paul, Minn., September 12-15.

International Municipal Congress and Exposition. Chicago, Ill., September 18-30.

American Electrochemical Society. Twentieth general meeting, Toronto, Canada, September 21-23.

Illuminating Engineering Society. Annual convention, Chicago, Ill., September 25-27.

American Mining Congress. Thirteenth annual meeting, Chicago, Ill., September 25-30.

American Electric Railway Association. Annual convention, Atlantic City, N. J., October 9-13.

Association of Railway Electrical Engineers. Annual convention, La Salle Hotel, Chicago, November 6-10.

RECORD OF ELECTRICAL PATENTS.

Issued (United States Patent Office) July 11, 1911.

997,262. ELECTRIC-TROLLEY WHEEL. William H. Bean, Ferndale, Pa. Filed Dec. 22, 1910. The wheel is in three parts, the central body portion and two flanged portions. The body part fits loosely on the axle.

997,280. ELECTRIC CONTROLLER. Arthur C. Eastwood, Cleveland, Ohio, assignor to Electric Controller & Manufacturing Co., Cleveland, Ohio. Filed Sept. 24, 1910. Comprises a motor, a magnetically operated reverser therefor, a resistance, one or more switches having contacts connected to the resistance, means when the reverser is in its open position for connecting both ends of its operating winding to the same side of a source of supply when any of the resistance switches is closed.

997,288. CONNECTING CIRCUIT FOR TELEPHONE EXCHANGES. Everett D. Hall, New York, N. Y., assignor to Western Electric Co., New York, N. Y. Filed Dec. 8, 1910. Combined with test terminals is a switch having a conductor adapted to connect with them, a pair of relays in the conductor governed by the electrical condition of the test terminals, a repeating coil controlled by one relay, and a battery for talking purposes and common battery supervisory signal apparatus controlled by the other relay.

997,295. SMOOTHING DEVICE. Arthur Hofheimer, York, Pa., assignor to Heany Fire-Proof Wire Co., New York, N. Y. Filed

Dec. 8, 1910. A wire-insulating device comprises a die, a support therefor consisting of an angular hood having upturned flanges at its sides, and a burner located beneath the hood.

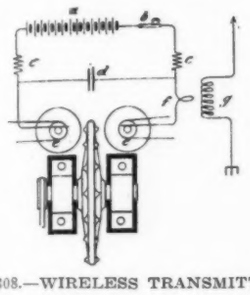
997,308. TRANSMITTING APPARATUS FOR WIRELESS TELEGRAPHY. Guglielmo Marconi, London, England, assignor to Marconi Wireless Telegraph Company of America, New York, N. Y. Filed July 15, 1910. Consists of a battery of low resistance, a condenser adapted to be charged thereby, a pair of terminals connected to the condenser, an inductance in series with the condenser and terminals, means for rotating the terminals and means operating at intervals bearing an integral ratio to the electrical time period of the circuit containing the condenser and battery for bridging the gap between the terminals.

997,316. ELECTRIC SWITCH. John Morse and Frederick Thomas Kaelin, Montreal, Quebec, Canada. Filed June 17, 1909. A knife-blade switch is provided with a bolt and locking means.

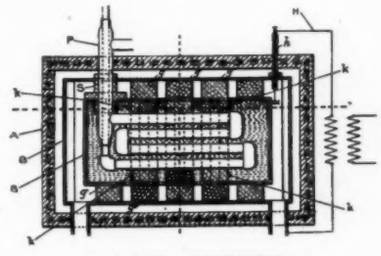
997,322. ELECTROSTATIC SEPARATOR. Clarence Q. Payne, New York, N. Y. Filed March 15, 1911. Combined with a charging electrode is a separating electrode formed of a series of conducting disks, the edge faces of adjoining disks being separated. There are means for causing an electrical discharge through one electrode to the other, and means for passing the material to be separated through the region of discharge between the electrodes.

997,332. CIRCUIT-BREAKER. William M. Scott, Philadelphia, Pa. Filed May 25, 1910. Has a movable laminated-copper contact member, an operating member therefor, an actuator, a roller upon the operating member, a dog pivoted on the actuator and thrusting against the roller, and dog-actuating member pivoted on the operating member and adapted to disengage the dog from the roller.

997,337. MAGNETIC SHIELDS FOR ELECTRIC MACHINES. Charles H. Smoot, Chicago, Ill., assignor to Rateau Turbine Co., Chicago, Ill. Filed Feb. 16, 1907. Renewed Nov. 23, 1910. The revolving armature has steel retaining bands and stationary iron shields surrounding its end portions concentric therewith and acting to absorb the leakage field.



997,308.—WIRELESS TRANSMITTER.



997,339.—OZONIZER.

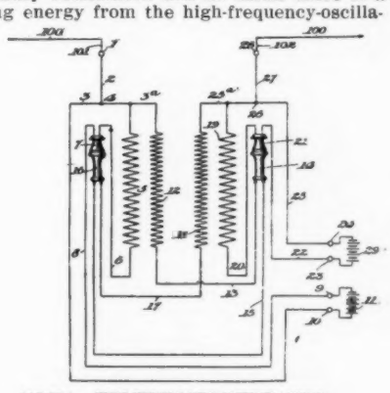
997,460. INCANDESCENT-LAMP GUARD. William N. Matthews, St. Louis, Mo., assignor to W. N. Matthews & Brother, St. Louis, Mo. Filed Jan. 11, 1909. Has a wire cage for inclosing the lamp bulb, a spacing ring and bottom guard for the lower end of the cage, which guard comprises two or more wires interlooped to form a center portion, and laterally projecting hooks to engage the spacing ring on the bottom of the cage.

997,465. ELECTRIC HEATER. Frank P. Mies, Chicago, and James J. McGerry, Edgewater, Ill. Filed Jan. 25, 1910. Comprises a fan having air-moving blades within a casing, an electric conductor wound about the blades and adapted to heat the air within the casing, a centrifugally operated switch for closing the circuit containing the heating conductor when the fan reaches a predetermined speed.

997,467. ELECTRIC COOKER. Will Nichols, Denver, Colo., assignor to one-half to Adam F. Rexroad, Denver, Colo. Filed March 11, 1910. Comprises a disk having a recess therein, heating coils located within the recess, contact sockets located in the disk and connected with the coils, a portable eletrode adapted to be inserted in the contact sockets and connected in operative relation with the coils.

997,475. INSULATED RAIL-JOINT. Peter G. Ten Eyck, Albany, N. Y. Filed April 12, 1909. Insulation is placed between and permanently attached throughout its entire length to both the fish plate and the holding plate.

997,515. SIGNALING APPARATUS. Harry Shoemaker, Jersey City, N. J. Filed Nov. 15, 1910. In a wireless system having a source of high-frequency oscillations and an aerial there is a link circuit transferring energy from the high-frequency-oscillation producer to the radiating conductor, the link circuit having inductance and substantially no capacity.



997,594.—TELEPHONE REPEATER.

997,516. RECEIVING APPARATUS. Harry Shoemaker, Jersey City, N.J. Original application filed Nov. 15, 1910. Divided and this application filed Jan. 12, 1911. An aerial receiving conductor has an inductance associated therewith, a tuned circuit including an inductance, and a conductively separate link circuit having coils closely inductively related respectively with each of the inductances, the link circuit having practically no capacity.

997,520. CONTROLLER. Morris S. Towson, Cleveland, O. Filed May 19, 1909. In a motor-control system, a motor having a field winding consisting of two sets of independent coil sections, and a controller having means for connecting all the sections of two sets in series, for changing the sections of one set from series to series parallel, and for short circuiting different numbers of the sections of the other set.

997,563. ROTARY SNAP-SWITCH. Samuel Korf, Chicago, Ill., assignor to Wi-Ko Electric Co., Chicago, Ill. Filed June 6, 1910. Has a ratchet wheel of non-conducting material provided with a band of conducting material having projections corresponding with elongated teeth on the ratchet wheel, contact strips adapted to simultaneously contact with two of the band projections, and means to rotate the ratchet wheel.

997,564. ROTARY SNAP-SWITCH. Samuel Korf and Robert Witz, Chicago, Ill., assignors to Wi-Ko Electric Co., Chicago, Ill. Filed July 30, 1910. A lamp cluster has mounted on it a removable box containing the switch described above which is operated by a single pull chain.

997,576. TROLLEY FOR ELECTRIC RAILWAYS. James H. Mountain, deceased, Terre Haute, Ind., by Laura Mountain, administratrix, Terre Haute, Ind. Filed March 31, 1911. Relates to a rotatable connection between the trolley harp and trolley pole.

997,579. DYNAMO-ELECTRIC MACHINERY. Charles Algernon Parsons and A. Henry Law, Newcastle-upon-Tyne, England; said Law assignor to said Parsons. Filed July 9, 1909. Comprises an armature core, poles coacting with the core and separated therefrom by an air gap, electric conductors at least partially imbedded in the core and an auxiliary conductor electrically connected in parallel with each of the former conductors around the periphery and situated in the air gap.

997,338. STEREOSCOPIC APPARATUS. Homer Clyde Snook and Edwin W. Kelly, Philadelphia, Pa. Filed Aug. 2, 1910. Two view boxes containing incandescent lamps and the objects to be viewed are mounted on opposite sides of a set of adjustable mirrors and curtains.

997,339. OZONIZER. Jan Steynis, New York, N. Y. Filed Sept. 15, 1909. Contains a hollow electrode with external discharge surfaces thereon at intervals and a cooling pipe within the electrode but insulated therefrom.

997,353. TIME-RECORDER. Ernest E. Yaxley, Chicago, Ill., assignor to Monarch Telephone Manufacturing Co., Chicago, Ill. Filed Feb. 20, 1911. Includes an electromagnetically operated time-character adjusting mechanism.

997,397. CIRCUIT-CONTROLLER. Arthur C. Livermore, Edgewood Borough, Pa., assignor to Union Switch & Signal Co., Swissvale, Pa. Filed March 16, 1911. A controller for governing the circuit of a track-switch operating mechanism.

997,406. KEY-SOCKET SWITCH MECHANISM. Harry J. Morey and Fay A. Brogden, Syracuse, N. Y. Filed March 1, 1911. An incandescent-lamp socket has a quick acting key switch.

997,413. ELECTRIC INCANDESCENT LAMP. Hermann Carl Gustav Remane, Berlin, Germany, assignor to General Electric Co. Filed Oct. 3, 1905. An incandescent filament has a metallic support therefor permanently connected with it by means of an enlarged portion of fused metal located at the extremity of the support and entirely surrounding the filament, the portion being of the same material as the support and being in the form of a smooth globule.

997,458. ELECTRIC BRAKE. Joseph N. Mahoney, Wilkinsburg, and Walter M. Austin, Swissvale, Pa., assignors to Westinghouse Air Brake Co., Pittsburg, Pa. Filed Aug. 29, 1908. A running controller has a handle adapted to be moved in one direction about one axis of rotation from its neutral position for running and in the opposite direction about another axis of rotation for braking.

997,588. LAMP-SOCKET. Edward E. Taylor and David H. Elkins, Amesbury, Mass., assignors to William Gray, Amesbury, Mass. Filed August 11, 1910. Has a cylindrical cap flexibly secured over a porcelain shank containing the connecting wires so as to make the lamp mounting less rigid laterally.

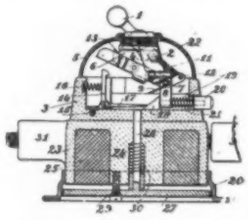
997,594. TELEPHONE REPEATER. Willard Anderson, Longdale, Okla. Filed Nov. 12, 1909. The repeater is placed in series in the circuit and works in both directions. It comprises two transmitters, two receivers disposed in operative juxtaposition to the transmitters and two induction coils, the transmitters being connected respectively with the primaries of the coils, the ends of the primary and secondary of each coil being in connection.

997,597. CURRENT-COLLECTOR OR TROLLEY. William Arter, Richmond Hill, N. Y. Filed Dec. 28, 1908. Comprises a rectangular frame, a contact roller journaled in its ends, vertically disposed plates mounted on the sides of the frame, a number of parallel, supplemental conductors, resilient arms secured to the plates and supporting the conductors, and supporting means for the frame.

997,598. LOCK FOR SOCKET SHELLS. Tonjes August Carl Both, New York, N. Y., assignor to Ida S. Rosenheim, New York, N. Y. Filed April 29, 1911. The cap is provided with a rotatable locking ring. Locking means secure the shell and locking ring together, the locking means having an engaging part mounted and exposed between the mouth of the cap and the mouth of the shell.

997,650. EXTENSIBLE BRACKET. Andrew Dahlen, Chicago, Ill. Filed May 23, 1908. A lazy-tong device for supporting a desk telephone.

997,651. TELEGRAPHIC RECORDING APPARATUS. Thomas McClelland De Bingham, London, England. Filed July 22, 1910. Light passes through a capillary tube which is connected with an electrolyte container. A photographic plate is arranged so as to receive impressions from light traveling through the meniscus in the tube, and through the microscope.



997,759.—AUTOMATIC SWITCH.

997,670. ELECTRIC WATER-HEATER. Josef Henrik Hallberg, New York, N. Y. Filed Jan. 31, 1908. Water flows over a heating element in a tube; means also being provided for regulating water flow and heat with one operation.

997,756. TELEPHONY. George C. Cummins, Western Springs, Ill. Filed Oct. 14, 1909. A central-energy telephone system.

997,759. ELECTRIC SWITCH. Claude William Denny, Kensington, London, England. Filed July 30, 1910. A self-contained automatic tumbler switch is provided with an electromagnet, which opens the switch in the event of an overload.

997,838. THERMO-ELECTRIC CIRCUIT-BREAKER. Edward W. Leeper, Chicago, Ill., assignor to Frank B. Cook, Chicago, Ill. Filed May 28, 1904. Renewed Nov. 23, 1910. Combines a metallic resistance conductor, a toothed wheel threaded upon the conductor, a heat-susceptible material securing the wheel in place upon the conductor, under normal circuit conditions, and means for turning the wheel upon the conductor under abnormal circuit conditions, to operate a circuit controlling means.

997,879. TREATMENT OF REFRACTORY MATERIALS. Ezechiel Weintraub, Schenectady, N. Y., assignor to General Electric Co. Filed Dec. 4, 1906. A process for electrically heating impure boron in a vacuum to drive off the impurities.

997,880. TREATMENT OF REFRACTORY MATERIALS. Ezechiel Weintraub, Lynn, Mass., assignor to General Electric Co. Original application filed Dec. 4, 1906. Divided and this application filed Oct. 27, 1909. A process for melting a refractory body used as an anode for a mercury-vapor arc operating in hydrogen at low pressure.

997,881. APPARATUS FOR THE TREATMENT OF REFRACTORY MATERIALS. Ezechiel Weintraub, Schenectady, N. Y., assignor to General Electric Co. Original application filed Dec. 4, 1906. Divided and this application filed Nov. 12, 1907. Renewed Jan. 31, 1910. Apparatus for use in the process described in the foregoing patent

997,882. ELECTRIC FURNACE. Ezechiel Weintraub, Lynn, Mass. assignor to General Electric Co. Original application filed July 2, 1906. Divided and this application filed May 13, 1908. Renewed Feb. 23, 1911. The metal is melted in vacuo. Means are provided for rendering conductive the space between the anode and cathode to establish a heating arc and for concentrating the heating action of the arc on a limited portion of the anode.

997,883. TREATMENT OF REFRACTORY MATERIALS. Ezechiel Weintraub, Schenectady, N. Y., assignor to General Electric Co. Filed July 2, 1906. Renewed Feb. 23, 1911. Embodies apparatus carrying out the principle involved in the preceding patent.

997,897. ELECTRIC RAILWAY-SWITCH-OPERATING MECHANISM. Herman I. Blattle, Providence, R. I., assignor of one-half to Paul Newman, Providence, R. I. Filed Dec. 27, 1909. A solenoid magnet is pivotally hung and means are provided for engaging and acting upon the magnet core as the same moves outward from its shell to deflect its path of movement and throw the switch alternately in opposite directions each time the magnet is energized. The magnet is energized as desired by a passing car.

997,916. ELECTRIC-WIRE SUPPORTER. Solomon Jeremiah, Duquoin, Ill. Filed Oct. 12, 1908. A split tubular shell, which may be inserted in a hole, is expanded by a conical plug which is drawn into position by a bolt. A collar screwed to the outer end of the bolt is arranged to hold an insulator.

997,924. THERMO-ELECTRIC CIRCUIT-BREAKER. Edward W. Leeper, Chicago, Ill., assignor to Frank B. Cook, Chicago, Ill. Original application filed May 28, 1904. Divided and this application filed Dec. 14, 1906. Comprises a suitable support, an electro-thermal switch carried by the support, a plunger for setting the device to operative position, and a coil spring against which the plunger is depressed when the apparatus is set, the coil spring being arranged to operate the plunger upon abnormal electrical conditions in the device.

997,926. CHANDELIER FOR GAS OR ELECTRIC LIGHTING. Charles A. Luther, Chicago, Ill. Filed April 12, 1910. A semi-indirect fixture using gas mantle burners over an inverted art-glass dome and electric bracket lamps at the edge of the dome.

PATENTS THAT HAVE EXPIRED.

Following is a list of the electrical patents (issued by the United States Patent Office) that expired July 17, 1911:

522,964. MANUFACTURE OF INCANDESCENT ELECTRIC LAMPS. Henry D. Burnett, Lynn, and Samuel E. Doane, Swampscott, Mass.

522,972. THERMOSTATIC ALARM. Charles Cuttriss, New York, N. Y.

522,986. SYSTEM OF ELECTRIC DISTRIBUTION AND GENERATION. Edwin J. Houston, Philadelphia, Pa.

522,988. METHOD OF AND APPARATUS FOR TRANSFORMING ALTERNATING INTO CONTINUOUS CURRENT. John F. Kelly, Pittsfield, Mass.

522,999. ELECTRICAL CONNECTION CORD. Alfred H. McCulloch, Boston, Mass.

523,007. ELECTRIC-LAMP SUPPORT. James J. Renehan, New Britain, Conn.

523,019. COMMUTATOR FOR DYNAMO-ELECTRIC MACHINES. Elihu Thomson, Swampscott, Mass.

523,074. ELECTRIC SWITCH. Jesse F. Kester, Buffalo, N. Y.

523,104. ELECTRIC-RAILWAY SUPPLY SYSTEM. William A. Butler, New York, N. Y.

523,120 and 523,121. ELECTRIC SIGNALING APPARATUS. William W. Hibbard, Rochester, N. Y.

523,122. DIFFERENTIATING APPARATUS FOR ELECTRIC SIGNALING SYSTEMS. William W. Hibbard, Rochester, N. Y.

523,123 and 523,124. ELECTRIC SIGNAL-BOX. William W. Hibbard, Rochester, N. Y.

523,140. ELECTRIC MOTOR. Julian F. Denison, New Haven, Conn.

523,144. ELECTRIC ARC LAMP. Walter E. Frost, Lewiston, Me.

523,146. CONDUIT ELECTRIC RAILWAY. Charles D. Jenney, Indianapolis, Ind.

523,160. ELECTRICAL CONDUCTOR. Gilbert H. Blakesley, Bristol, Conn.

523,164, 523,165 and 523,166. SUPPLY SYSTEM FOR ELECTRIC RAILWAYS. Edward H. Johnson, New York, N. Y.

523,172. ELECTRIC-RAILWAY CROSSING INSULATOR. Henry B. Nichols and Frederick H. Lincoln, Philadelphia, Pa.

523,204. INCANDESCENT ELECTRIC LAMP. William E. Forest, New York, N. Y.

523,264. MATERIAL FOR MAKING ELECTRIC-LIGHT FILAMENTS. Gustave A. Cannot, London, England.

523,271. CONDUIT ELECTRIC RAILWAY. John W. Eisenhuth, San Francisco, Cal.

523,276. TELEPHONE TRANSMITTER. Theodore Grissinger, Mechanicsburg, Pa.

523,278. ELECTRIC RAIL BOND. James G. Hallas, Waterbury, Conn.

523,384. BONDING JOINT FOR ELECTRIC RAILWAYS. Andrew L. Johnson, Richmond, Va.

523,305. INCANDESCENT ELECTRIC LAMP. John E. Criggel, Springfield, Mass.

523,306. ELECTRIC RAILWAY. Henry A. Doty, Janesville, Wis.

523,313. ELECTRIC-RAILWAY SYSTEM. Rudolph M. Hunter, Philadelphia, Pa.

523,319. ELECTRICAL-CONDUCTOR FOR TROLLEYS. John W. Eisenhuth, San Francisco, Cal.